STATE OF NEW MEXICO
ENVIRONMENTAL IMPROVEMENT BOARD

IN THE MATTER OF THE AMENDED PETITION TO CONSIDER PROPOSED AMENDMENTS TO THE LIQUID WASTE DISPOSAL AND TREATMENT REGULATIONS, 20.7.3 NMAC

EIB 12-01 (R)

NEW MEXICO ENVIRONMENT DEPARTMENT, Petitioner

<u>INFILTRATOR SYSTEMS INC.'S NOTICE OF INTENT TO PRESENT TECHNICAL TESTIMONY</u>

Infiltrator Systems Inc. (Infiltrator), by and through its undersigned counsel Sheehan & Sheehan, P.A. (Susan C. Kery), submits to the New Mexico Environmental Improvement Board (Board) this Notice to Present Technical Testimony at the hearing before the Board, to be held on August 6, 2012 and continuing thereafter as necessary, to consider proposed amendments by the New Mexico Environment Department (Department) to the Liquid Waste Disposal and Treatment Regulations, 20.7.3 NMAC. Pursuant to 20.1.1.302 NMAC, the following information is provided to the Board:

1. <u>The entity for which the witness will testify.</u>

The witness will testify on behalf of Infiltrator, a manufacturer of plastic leachfield drainage products for on-site wastewater disposal systems.

2. <u>The name and qualification of Infiltrator's technical witness.</u>

<u>Dennis F. Hallahan, P.E.</u> Mr. Hallahan has worked for Infiltrator for thirteen years and is currently its Technical Director. In that position, he is responsible for government relations and technology transfer between Infiltrator and the regulatory and design communities. Mr. Hallahan is responsible for product research and testing at universities, test centers and private consultants. Mr. Hallahan develops system sizing charts for national and international approvals

and assists customers and field representatives in the planning and review of large commercial decentralized systems.

Mr. Hallahan has twenty-four years of experience in the design and construction of on-site wastewater treatment systems. He has authored several articles for on-site industry magazines and has given numerous presentations nationally on the science and fundamentals of on-site wastewater treatment systems. Mr. Hallahan also holds patents for on-site wastewater products and has served for several years on the National Onsite Wastewater Recycling Association (NOWRA) Technical Practices Committee. Mr. Hallahan is a licensed professional civil engineer in Connecticut. He received his Masters Degree in Civil Engineering from the University of Connecticut and a Bachelor of Science Degree in civil engineering from the University of Vermont.

3. Testimony of Mr. Hallahan.

The testimony of Mr. Hallahan is attached hereto as Attachment 1. The anticipated duration of Mr. Hallahan's testimony will be one hour.

4. Exhibits. Infiltrator will or may use the following exhibits at the hearing. These exhibits are attached hereto as Attachment 2:

A. State of New Mexico Environment Department, Liquid Waste Disposal Regulation Amendments, Major Issue Status with Proposed NMAC (April 5, 2005);

B. Testimony of NMED Environmental Health Division Before the Environmental Improvement Board (January 3, 2007);

C. Order and Statement of Reasons for Amendment of Regulations, EIB No. 06-060(R), 06-07(R), 06-13(R), In the Matter of the Proposed Amendments to Liquid Waste Disposal and Treatment Regulations 20.7.3 NMAC, New Mexico Environment Department, Petitioner (May 1, 2007);

D. United States Environmental Protection Agency *Onsite Wastewater Treatment Systems Manual* (February 2002);

E. Uniform Plumbing Code, 2000 Edition, Appendix K;

F. Calculation: Sizing Comparison Between Existing and Proposed Regulations;

G. Charts: Sizing Comparisons Between New Mexico and Certain States;

H. Liquid Waste Program, 2011 Stakeholder Outreach Initiative, Summary of, and Responses to, Stakeholder Recommendations (December 12, 2011); and

I. New Mexico Economic Development Department *Small Business-Friendly Task Force Report* (April 1, 2011).

5. Recommended modification to proposed changes.

Infiltrator recommends the Board reject the amendments proposed by the Department, as follows:

a. 20.7.3.703.J (2) NMAC: The Department proposes to delete this entire section of the regulation. The proposed deletion should not be adopted, and the following language should remain in the regulations: "A minimum of six inches of aggregate shall be placed below the invert of the distribution pipe to provide surge storage. This area of trench sidewall shall not be used in calculating the absorption area."

b. 20.7.3.703.J (4) NMAC: The Department proposes to delete the words "excluding the six inches of trench sidewall required in Paragraph (2) of this subsection" and add the words "below the distribution pipe". The Department's proposed amendments should not be adopted by the Board, and the following language should remain in the regulations: "The total absorption area shall be calculated utilizing the total trench bottom and sidewall area, excluding the six inches of trench sidewall required in Paragraph 2 of the subsection."

6. Reservation of Rights.

This Notice of Intent to Present Technical Testimony is based on the Amended Petition filed by the Department on May 2, 2012 describing proposed amendments to the Liquid Waste Disposal and Treatment Regulations found at 20.7.3 NMAC. Infiltrator reserves the right to call any person to testify and to present any exhibit in response to another Notice of Intent or public comment filed in this matter, to any testimony or exhibit offered at the public hearing, or to any further proposed amendments of the Liquid Waste Treatment and Disposal Regulations by the Department. Infiltrator also reserves the right to call any person as a rebuttal witness and to present any exhibit in support thereof.

Respectfully submitted,

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BY: Susan C Kery
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I HEREBY CERTIFY that a true and correct copy of the foregoing pleading was hand-delivered this 17th day of July, 2012 to:

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Testimony of Dennis F. Hallahan, P.E on Behalf of Infiltrator Systems Inc.

I. Introduction.

Infiltrator Systems Inc. ("Infiltrator") is the manufacturer of plastic products used in septic system drainfields in lieu of gravel or other drainfield products. Infiltrator products are widely used in the United States and New Mexico. By virtue of its products, Infiltrator is interested in state regulations regarding the sizing of drainfields.

The New Mexico Environment Department ("NMED" or "Department") has proposed amendments to 20.7.3.703.J NMAC. That regulation currently states that disposal trenches shall conform to the following requirement: "A minimum of six inches of aggregate shall be placed below the invert of the distribution pipe to provide surge storage. This area of trench sidewall shall not be used in calculating the absorption area." 20.7.3.703.J (2) NMAC. This regulation further states: "The total absorption area shall be calculated utilizing the total trench bottom and sidewall area, excluding the six inches of trench sidewall required in Paragraph 2 of the subsection." 20.7.3.703.J (4) NMAC. NMED has proposed amendments to this regulation eliminating the six inches of surge storage, and allowing all sidewall below the invert of the pipe to be credited in the calculation of the total absorption area. If adopted, these amendments would increase the sidewall credit of a liquid waste disposal system and result in significant decreases to the size of the system. At first glance the proposed amendments have been presented as a simple proposal to "reflect water conservation practices in the state." (*See* May 31, 2012 Public Notice). Nonetheless, when analyzed in detail it is clear that the proposed amendments (1) are not based on any supporting scientific evidence, including evidence presented to the Environmental Improvement Board ("Board" or "EIB") in the past; (2) are contrary to recent positions taken by NMED; and (3) will result in a net loss in protection of public health for the citizens of New Mexico.

This testimony discusses:

1. The regulatory history of 20.7.3.703.J.
2. The evidence supporting Infiltrator's position, as shown by:
    a. USEPA manual recommendations;
    b. The Uniform Plumbing Code; and
    c. New Mexico System sizing comparisons.
3. The Department's justification for the proposed amendments to 20.7.3.703.J.

II. The Regulatory History of 20.7.3.703.J.

Regulation 20.7.3.703.J NMAC is commonly referred to as the "sizing regulation" because it dictates the size of drainfields. The regulation will be referred to herein as the "sizing regulation". As set forth below, the sizing regulation has been the subject of much discussion and study in New Mexico since 2003.

In the fall of 2003, a working group of stakeholders began meeting regularly to discuss a variety of issues relating to the Liquid Waste Disposal and Treatment Regulations ("Regulations.") Representative from Infiltrator were actively involved in that process. Many aspects of the Regulations were discussed, including extensive discussions on the sizing regulation.

In December, 2004 a hearing was held before the Board on NMED's petition to repeal and replace the Regulations. After the conclusion of the December hearing, the Department and interested stakeholders reached a compromise on the sizing regulation, through the following process. On February 23-24, 2005, in order to resolve the drainfield sizing issue, the Wastewater Technical Advisory Committee (WTAC) held a meeting in which two national experts in drainfield sizing, Dr. Robert Siegrist and Dr. Kevin White, gave presentations on the issue of proper drainfield sizing. Based on information presented at this meeting, NMED and interested parties, including Infiltrator, developed a compromise regulation. The compromise regulation (which is the current sizing regulation) was based on the following technical considerations:

- Shallow, narrow drainfields are desirable to maximize wastewater treatment and infiltration.
- For most soils, long-term infiltration rates are determined more by the hydraulic conductivity of the biomat rather than by soil texture. Regulatory application rates based on soil texture should be modified to reflect this phenomenon.
- Significant sidewall infiltration occurs only in areas of trench ponding.
- A total of eighteen to twenty-four inches of sidewall would be appropriate to count as infiltrative surface.
- Six inches of sidewall below the invert of the drainpipe, to be excluded from sidewall absorption area, should be adequate as a peak flow storage factor.

Based on these considerations, NMED and interested parties developed the following recommendations for drainfield sizing regulation amendments:

- Reduce peak flow storage capacity from the current twelve inches to six inches below the invert of the drainpipe.
- Reduce the minimum trench width from eighteen inches to twelve inches.
- Allow up to three feet of sidewall to be credited towards infiltrative surface area, below the six-inch storage capacity, with a maximum of seven square feet per linear foot of drainfield for any configuration.
- Amend application rates for soil texture as suggested by the experts.
- A maximum drainfield size reduction of 30%, for either advanced treatment or proprietary products but not for both, would be allowed.

- Sizing of proprietary drainfield products shall be as recommended by the WTAC and approved by the Department Secretary.

See, State of New Mexico Environment Department, Liquid Waste Disposal Regulation Amendments, Major Issue Status with Proposed NMAC (April 5, 2005), Attachment 2, Exhibit A.

Based on these recommendations by NMED and interested stakeholders, the sizing regulation was amended, such amendment was approved and adopted by the Board, and set forth in the Regulations which became effective on September 1, 2005. This is the current sizing regulation which NMED now proposes to amend.

In 2006, NMED proposed amendments to the Regulations "for their improvement and clean-up." *See* Testimony of NMED Environmental Health Division Before the Environmental Improvement Board (January 3, 2007), Attachment 2, Exhibit B, p. 1. The Department addressed the sizing regulation in the testimony it presented to the Board:

> The issue of absorption area was discussed extensively during the regulation amendment proceedings of 2004-05. Two national drainfield experts were brought in for a special Wastewater Technical Advisory Committee meeting on drainfield sizing. Both experts identified surge storage capacity as a necessary safety factor for drainfield design, and recommended a capacity of 12 to 18 inches below the invert of the drain pipe. After further discussion, however, NMED and other parties agreed to reduce the surge capacity from twelve to six inches, and six inches was adopted by the EIB. <u>POWRA [Professional On-Site Wastewater Re-Use Association of New Mexico] proposes to eliminate the six inches of surge capacity and calculate absorption area starting at the bottom of the invert of the drain pipe. NMED opposes the POWRA proposal on the basis that it offers no protection for surge capacity, and is contrary to the advice of the national experts who were consulted on the issue.</u>

Id. at p. 9 (emphasis added.) The amendments now proposed by NMED are the very amendments it opposed in 2007. Infiltrator is aware of no technical basis in support of the proposed amendments to the sizing regulation. As such, the Department is now acting "contrary to the advice of the national experts who were consulted on the issue," and directly contrary to the position the Department took in 2007.

A hearing on the 2006 proposed amendments to the Regulations was held on January 3-7, 2007. On May 1, 2007, the Board issued its Order and Statement of Reasons for Amendment of Regulations. *See* Attachment 2, Exhibit C. Under its Statement of Reasons, the Board found that the following were grounds for NMED's position regarding the issue of "Surge Storage Capacity" in 20.7.3.703.J NMAC (in other words, that the sizing regulation adopted in 2005 should remain unchanged):

- The Board had previously adopted the six inch measurement.
- The six inch measurement is an important safety factor for the whole equation.
- The six inch measurement is on par and comparable with other states.
- A zero inch measurement appears to be too low of a figure.
- The lack of health problems refutes the argument that the current measurement lacks merit.
- Cost and economic concerns should be weighed (with the approximate $500-$1,000 extra expense at the six inch measurement) but environmental and human health protection outweigh these cost concerns.
- The six inch measurement was a negotiated figure by stakeholders at a previous Board rule-making.
- This rule-making hearing was intended to clean-up regulations and not to re-open major stakeholder issues.

It is abundantly clear that much time, energy, and thought was behind the amendment to the sizing regulation which is set forth in the current Regulations. To date, the only reasoning offered by NMED to support the proposed amendments are the recommendations of the Small Business-Friendly Task Force, which will be discussed below, and the cursory comment set forth above relating to water conservation.

III. The Evidence Supports Infiltrator's Position that NMED's Amendments Should Not Be Adopted.

The design and function of drainfields, trenches, and beds, including the infiltration of wastewater and the appropriate loading rates for such features, has been extensively studied. Those studies, the recommendations of Siegrist and White referenced in Exhibits A and B, as well as its own analysis, support the position of Infiltrator.

A. USEPA Recommendations.

The Department's proposal to increase the sidewall credit places too much emphasis on the sidewall. The Onsite Wastewater Treatment Systems Manual (2002) ("Manual") was developed by the United States Environmental Protection Agency ("EPA"). *See* Attachment 2, Exhibit D. The Manual was issued in 1980, updated in 2002, and is widely used in the onsite industry. It provides current information on onsite wastewater treatment system siting, design, installation, maintenance, and replacement. It also provides technical guidance for the design, construction, operation, maintenance, and regulation of onsite systems. The Manual was the result of the combined efforts by many industry professionals. The Manual reflects current thinking in the field, and is based on a review of research. As shown below, the Manual does not suggest over-crediting sidewall credit to the extent now proposed by NMED:

- Part 4.4.5 Sizing of the infiltration surface (p. 4-10):

Both the bottom and sidewall area of the SWIS [subsurface wastewater infiltrator system] excavation can be infiltration surfaces; however if the sidewall is to be an active infiltration

surface, the bottom surface must pond. If continuous ponding of the infiltration surface persists, the infiltration zone will become anaerobic, resulting in a loss of hydraulic capacity. Loss of the bottom surface for infiltration will cause the ponding depth to increase over time as the sidewall also clogs (Bouma, 1975; Keys et al., 1998; Otis, 1977). If allowed to continue, hydraulic failure of the system is probable. Therefore, including sidewall area as an active infiltration surface in design should be avoided.

The trend nationally has been to install shallow systems to allow for better treatment. Placing systems shallow allows for better oxygen transfer, better nutrient uptake by plants, and permits evapotranspiration. By giving more credit for sidewall as proposed by NMED, systems will be designed and installed deeper and with shorter lengths. The Manual addresses both depth and oxygen concerns:

- Section 4.3 Subsurface wastewater infiltration (p. 4-4):

  If sufficient oxygen is not present, the metabolic processes of the microorganisms can be reduced or halted and both treatment and infiltration of the wastewater will be adversely affected (Otis 1985).

- Part 4.3.1 SWIS designs (p. 4-4):

  Seepage pits are deep, circular excavations that rely almost completely upon sidewall infiltration. Seepage pits are no longer permitted in many jurisdictions because their depth and relatively small horizontal profile create a greater point-source pollutant loading potential to ground water than other geometries. Because of these shortcomings, seepage pits are not recommended in this manual.

- Section 4.4 Design considerations (p. 4-6):

  Onsite wastewater treatment system designs vary according to the site and wastewater characteristics encountered. However, all designs should strive to incorporate the following features to achieve satisfactory long term performance:
  - *Shallow placement of the infiltration surface (≤ 2 feet below the final grade)*

- Part 4.4.1 Placement of the infiltration surface (p. 4-6):

  The depth below final grade is affected by subsoil reaeration potential. Maximum delivery of oxygen to the infiltration zone is most likely when soil components are shallow and narrow and have separated infiltration areas. (Erickson and Tyler, 2001).

B. The Uniform Plumbing Code.

The Uniform Plumbing Code (2000) ("UPC") also supports Infiltrator's position that the sizing regulation amendments proposed by NMED should not be adopted. Designated as an American National Standard, the UPC is a model code developed by the International

Association of Plumbing and Mechanical Officials ("IAPMO") to govern the installation and inspection of plumbing systems as a means of promoting the public's health, safety and welfare. The UPC is developed using the American National Standards Institute's consensus development procedures. This process brings together volunteers representing a variety of viewpoints and interests to achieve consensus on plumbing practices. New Mexico has adopted the UPC in the New Mexico Plumbing Code. *See* 14.8.2.8 NMAC. The New Mexico Plumbing Code is cited as guidance in the Regulations. *See, e.g.,* 20.7.3.504.B.

The UPC at Appendix K, p. 330 (K 3(1) Area of Disposal Fields and Seepage Pits) sets forth design standards for disposal fields:

> When disposal fields are installed, a minimum of one hundred fifty (150) square feet (14 m^2) of trench bottom shall be provided for each system exclusive of any hard pan, rock, clay, or other impervious formations. Side wall area in excess of the required twelve (12) inches (305 mm) and not to exceed thirty-six (36) inches (914 mm) below the leach line may be added to the trench bottom areas when computing absorption areas.

See Attachment 2, Exhibit E. Prior to the 2005 adoption of the Regulations, New Mexico credited sidewall in excess of twelve inches, but it reduced the requirement to six inches in 2005. Therefore, the current Regulations are not as stringent as the UPC requirements.

C. System Sizing in New Mexico.

The current proposal to give more credit to sidewall will allow systems in New Mexico to become smaller. Currently systems are given credit for sidewall in excess of the first six inches; the new changes would allow all of the sidewall to be credited (below the invert of the pipe). Currently, New Mexico has some of the smallest drainfields in the country. The proposed changes will further reduce the size of systems, as shown in the drainfield sizing comparison calculations and charts. *See* Attachment 2, Exhibits F and G. The Department's proposed amendments are less protective of human health and the environment. As discussed throughout this testimony, septic system longevity and performance are directly related to size; the smaller drainfields are more prone to fail.

IV. The Department's Justification for the Proposed Amendment to 20.7.3.703.J.

Infiltrator's understanding is that NMED has proposed amendments to the Regulations based on stakeholder comments and recommendations of the Small Business-Friendly Task Force. A review of both offers no support for amending the sizing regulation.

A. Stakeholder Comments.

Infiltrator has reviewed all stakeholder comments available on the Liquid Waste Program's website, found at http://www.nmenv.state.nm.us/fod/LiquidWaste/. The Liquid Waste Program placed a document on its website titled Liquid Waste Program, 2011 Stakeholder

Outreach Initiative, Summary of, and Responses to, Stakeholder Recommendations (December 12, 2011). *See* Attachment 2, Exhibit H. That document addressed drainfield sizing as follows:

> Drainfield Sizing – One installer recommended that the 30% reduction for proprietary products be eliminated, and that 703.1 application rates be increased from 2.0 to 2.25 sqft/gal.day and 5.0 to 5.7 sqft/gal.day. An NMED inspector recommended that sizing requirements for clay soils were too cost prohibitive and should be reduced. The 30% reduction rule and application rates were adopted as regulations after extensive review and discussions with experts. Any amendments to these regulations should have a solid scientific basis.

Id. at p. 6. By its own words, NMED recognizes that any changes to drainfield sizing must be based on solid science. Infiltrator is not aware of any scientific data relied on by NMED to support its proposed amendments.

B. Small Business-Friendly Task Force Report.

It is Infiltrator's understanding that the proposed amendment to the sizing regulation is based on the Small Business-Friendly Task Force Report (April 1, 2011) ("Report"). *See* Attachment 2, Exhibit I. Although the Report lists 20.7.3.703.J(2) NMAC as a regulation which should be repealed, the Report provides no specific justification for such repeal, just the general justification that such repeal "will benefit New Mexico's small businesses so they are able to create jobs and keep New Mexico competitive." *Id.* at p. 1.

V. Conclusion.

The proposed amendments to the sizing regulation will have a significant impact upon the level of environmental protection provided by onsite wastewater treatment systems. The current body of scientific evidence supports systems to be installed at shallow depths rather than deeper depths; the proposed amendments to the sizing regulation will encourage the latter. The current sizing regulation provides better treatment and better factors of safety for the citizens of New Mexico, and should therefore not be amended as proposed by the Department.

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Liquid Waste Disposal Regulation Amendments
Major Issue Status with Proposed NMAC
April 5, 2005

Drainfield Sizing (403 existing, 703 relocated)

The reg re-write committee adjusted the current drainfield sizing requirements to count sidewall, while attempting to keep the required area the same. As Carlos Romero calculated, some drainfields would have been about the same, but others would have been larger or smaller depending on trench geometry. NMED felt that what was really needed was a thorough soil physics analysis of the issue, rather than mathematically repackaging the current requirements. This is why NMED decided not to propose changes to drainfield sizing regulations last summer. POWRA proposed changes that would give credit of up to three feet of sidewall, below the invert of the drainpipe, for sizing purposes.

This was a disputed issue at the December hearing, and the parties decided that the WTAC should hold a special meeting to develop drainfield sizing criteria based on state-of-the art knowledge. NMED issued professional services contracts with two national experts in the matter, Dr. Robert Siegrist and Dr. Kevin White, and the meeting was held on February 24, 2005. The experts made the following observations and recommendations:

- Shallow, narrow drainfields are desirable to maximize wastewater treatment and infiltration.
- For most soils, long-term infiltration rates are determined more by the hydraulic conductivity of the biomat rather than by soil texture. Regulatory application rates based on soil texture should be modified to reflect this phenomenon.
- Significant sidewall infiltration occurs only in areas of trench ponding.
- A total of 18 to 24" of sidewall would be appropriate to count as infiltrative surface.

- Six inches of sidewall below the invert of the drainpipe, to be excluded from sidewall absorption area, should be adequate as a peak flow storage factor. (The current regulations require 12 inches of storage.)

The stakeholders developed the following recommendations for drainfield sizing rule amendments:

- Reduce peak flow storage capacity from the current 12" to 6" below the invert of the drainpipe.
- Reduce the minimum trench width from 18" to 12".
- Allow up to three feet of sidewall to be credited towards infiltrative surface area, below the six-inch storage capacity, with a maximum of seven square feet per linear foot of drainfield for any configuration.
- Amend application rates for soil texture as suggested by the experts.
- A maximum drainfield size reduction of 30%, for either advanced treatment or proprietary products but not for both, would be allowed.
- Sizing of proprietary drainfield products shall be as recommended by the WTAC and approved by the NMED Secretary.

20.7.3.703 DESIGN; AREA OF DISPOSAL FIELD AND SEEPAGE PITS

A. The minimum required absorption area in a disposal field in square feet, and in seepage pits in square feet of side wall, shall be predicated on the liquid waste design flow rate and shall be determined by utilizing the following Table 703.1 based on the soil classification found in the proposed location of the disposal field.

B. The soil classification shall be determined by two test holes located at opposite ends of the proposed disposal area.

C. A detailed soil profile, in accordance with USDA soil classification methodology, shall be submitted with the liquid waste application for each hole, indicating soil horizons, horizon thickness as a function of depth, and soil texture.

D. USDA soil surveys may be used where available to help assess typical soils in the area of the proposed installation.

E. The required absorption area shall be sized on the most restrictive soil horizon located below and within 4 feet of the bottom the absorption area.

F. Conventional treatment systems shall not be constructed in Type Ia soils where the depth to groundwater is less than 30 feet, Type IV soils, or gravel. For these soils, refer to 20.7.3.605 NMAC.

G. Effluent distribution to Type IV soils shall be accomplished by means of timed low pressure dosed distribution.

H. The required absorption area shall be calculated by the following formula: ABSORPTION AREA = Q X AR, where: Q = the design flow rate in gallons per day, AR = application rate (from Table 703.1)

Table 703.1: Application Rates by Soil Types for Conventional Treatment Systems

Soil Type	Soil Texture	Application Rate (AR) (sq. ft./gal/day)

~~area of the bed and is not to be included in any sidewall calculations.~~ In addition, leaching beds shall conform to the following:

(1) A minimum of six inches of aggregate shall be placed below the invert of the distribution pipes to provide surge storage. This area of bed sidewall shall not be used in calculating the absorption area.

(2) Up to an additional two feet of aggregate may be placed below the distribution pipes.

(3) The total absorption area shall be calculated utilizing the total bed bottom and sidewall area, excluding the six inches of bed sidewall require in Paragraph (1) above.

L. The minimum effective absorption area in any seepage pit shall be calculated as the excavated sidewall area below the inlet pipe exclusive of any hardpan, caliche, rock, clay, or other impervious formations and may be provided in one or more seepage pits.

M. For secondary and tertiary treated effluent, the minimum calculated absorption area required for conventional treatment may be reduced 30% and the maximum trench depth may be no greater than 10 feet. In no case shall the maximum reduction for the drainfield absorption area exceed 30%.
[10-15-97; 20.7.3.25 NMAC - Rp 20NMAC7.3.403, x/x/2003]

Stricter Standards/Areas of Concern (201.F existing, 201.M relocated)

Based on the testimony of Bob Garcia and others, and on the issues of AOC maps and signs, NMED proposes to eliminate the AOC definition and references to the definition throughout the regulations. The hydrogeological conditions of vulnerability in the AOC definition are more appropriately placed into the existing regulation at 201.F as examples of when NMED may impose stricter standards. This is consistent with how NMED currently applies the existing stricter standards regulation. NMED also proposes to retain the proposed concept of a letter of determination (201.O), that would be valid for one year, of whether or not stricter standards will be imposed on a lot or parcel of land.

20.7.3.7 DEFINITIONS:

~~(7) "area of concern" or "AOC" means a geographical area with sufficient geological or biological characteristics that may require increased protection of groundwater and surface water.~~
~~These areas may include but are not limited to:~~

~~(a) a water-table aquifer (includes both unconfined and semi-confined conditions) with a vadose zone thickness of 100 feet or less containing no soil or rock formation that would act as a barrier to saturated or unsaturated wastewater flow;~~

~~(b) sites within one quarter (1/4) mile of a known groundwater plume of anthropogenic anoxic or nitrate contamination caused by migration through undisturbed vadose zone, provided that the site overlies the same aquifer;~~

~~(c) an aquifer overlain by fractured bedrock;~~

~~(d) an aquifer in karst terrain; and,~~

~~(e) a gaining stream impacted by nutrients from liquid waste systems; and~~

20.7.3.201 PROCEDURES; GENERAL REQUIREMENTS

M. Nothing contained in 20.7.3 NMAC shall be construed to prevent the department from requiring compliance with more stringent requirements than those contained herein, where the department finds that such more stringent requirements are necessary to prevent a hazard to public health or the degradation of a body of water. The

Ia	Coarse Sand	~~0.83~~ 1.25 (See Subsection F of 20.7.3.703 NMAC)
Ib	Medium Sand, Loamy Sand	~~1.00~~ 2.00
II	Sandy Loam	~~1.27~~ 2.00
	Fine Sand, Loam	~~1.67~~ 2.00
III	Silt, Silt Loam, Clay Loam, Silty Clay Loam, Sandy Clay Loam, ~~Sandy Clay~~	~~2.20~~ 2.00
IV	Sandy Clay, Silty Clay, Clay	~~4.20~~ 5.00 (See Subsection G of 20.7.3.703 NMAC)

I. The gravel content of in place natural soil shall not exceed 30%:

J. ~~When trench disposal fields are installed, a minimum of one hundred and fifty (150) square feet of bottom area shall be provided for each system exclusive of any hard pan, caliche, rock, clay, or other impervious formations. Side wall area in excess of the required minimum of twelve (12) inches and not to exceed thirty-six (36) inches below the leach line may be added to the trench bottom area when computing total absorption areas. The minimum twelve (12) inches of sidewall is part of the total absorption area of the conventional trench and shall not be included in any sidewall calculations.~~

Disposal trenches shall conform to the following:

(1) The trench width shall be no less than one foot and no more than three feet.

(2) A minimum of six inches of aggregate shall be placed below the invert of the distribution pipe to provide surge storage. This area of trench sidewall shall not be used in calculating the absorption area.

(3) Up to an additional three feet of aggregate may be placed below the distribution pipe.

(4) The total absorption area shall be calculated utilizing the total trench bottom and sidewall area, excluding the six inches of trench sidewall require in Paragraph (2) above.

(5) The total absorption area shall not exceed seven square feet per linear foot of trench.

(6) A minimum of one hundred and fifty (150) square feet of bottom area shall be provided for each system exclusive of any hard pan, caliche, rock, clay, or other impervious formations.

K. Leaching (absorption) beds are allowed. The absorption area of the bed shall be at least fifty (50) percent greater than the minimum required absorption area for trenches with a minimum of two hundred and twenty-five (225) square feet of bottom area. ~~Perimeter sidewall area in excess of the required minimum of twelve (12) inches and not to exceed thirty-six (36) inches below the leach line may be added to the bed bottom area when computing total absorption areas. The minimum 12 inches of perimeter sidewall area is part of the total absorption~~

following parameters may be considered when determining if a body of water is potentially vulnerable to degradation from liquid waste effluents, and if more stringent requirements may be necessary to prevent such degradation:

(1) a water-table aquifer (includes both unconfined and semi-confined conditions) with a vadose zone thickness of 100 feet or less containing no soil or rock formation that would act as a barrier to saturated or unsaturated wastewater flow;

(2) sites within one quarter (1/4) mile of a known groundwater plume of anthropogenic anoxic or nitrate contamination caused by migration through undisturbed vadose zone, provided that the site overlies the same aquifer;

(3) an aquifer overlain by fractured bedrock;

(4) an aquifer in karst terrain; and,

(5) a gaining stream impacted by nutrients from liquid waste systems.

~~N. Lots located within an area of concern may require more stringent requirements pursuant to Subsection M of 20.7.3.201 NMAC.~~

O. Upon written request, and within ten working days upon request, the department shall provide a letter of determination stating whether or not more stringent requirements may be imposed on a lot or parcel of land ~~is located within an area of concern~~. This determination shall be valid for one year. ~~However, a lot not within an area of concern may require advanced treatment based on site specific conditions.~~

(All other references to AOC will be deleted or language changed consistent with 'more stringent requirements' as follows.)

20.7.3.202 PROCEDURES; MODIFICATION OF EXISTING SYSTEMS

C. On-site liquid waste systems modified after the effective date of this regulation:

(1) shall meet the lot size requirements of the regulations in effect at the time of the initial installation or most recent permitted modification; and,

(2) the total lot flow shall be increased only if all current standards and requirements are met pursuant to 20.7.3 NMAC. ~~If such systems are located within an area of concern,~~ More stringent requirements ~~may~~ could be required pursuant to Subsection M of 20.7.3.201 NMAC.

E. The modification of unpermitted systems shall be preceded by an inspection. If the system is found to be installed in accordance with the regulations in effect at the time of the original installation or most recent modification ~~and is not in an area of concern~~, a permit may be issued in accordance with Subsection C of 20.7.3.202 NMAC and Subsection J of 20.7.3.401 NMAC.

20.7.3.301 STANDARDS; LOT SIZE REQUIREMENTS:

F. On-site liquid waste systems installed after the effective date of these regulations, on lots with dates of record prior to February 1, 1990, without established on-site liquid waste systems shall conform to the following:

~~(6) lots located within an area of concern may require more stringent requirements pursuant to Subsection M of 20.7.3.201 NMAC.~~

20.7.3.402 PERMITTING; CONVENTIONAL TREATMENT AND DISPOSAL SYSTEMS

B. If the department finds ~~an on-site liquid waste system is proposed in an area of concern or~~ that specific requirements in addition to or more stringent than those specifically provided in 20.7.3 NMAC are necessary to prevent a hazard to public health or the degradation of a body of water, the department shall issue permit conditions with more stringent requirements or additional specific requirements. Such additional or more stringent requirements may apply to system design, siting, construction, inspection, operation and monitoring.

Tertiary Treatment Standards (proposed 603)

Both POWRA's and NMED's original petitions proposed to prorate the total nitrogen effluent limitation based on lot size according to the following equation,

total nitrogen (mg/L) = lot size (acres)/design flow (gpd) x 30,000.

The parties agree to retain this equation as originally proposed, that the regulations should explain the basis for this formula. Additionally, since not all samples are collected quarterly, the running average should be "6 sample" rather than "6 quarter".

20.7.3.603 DESIGN: TERTIARY TREATMENT STANDARDS

A. Tertiary treatment systems shall provide nutrient removal in addition to secondary treatment.

B. ~~In areas where depth to ground water is 101 feet or greater, tertiary treatment systems shall be allowed for reduced lot size based on the following formula.~~ Utilizing the standard loading equation, (flow (gpd) X conc. (mg/l) X 8.34 lbs./gal. X 365 days/yr)/ 1,000,000 gals = lbs./yr/ac., and assuming an average of 60 mg/l of TN in the septic tank effluent and a maximum flow of 500 gpd/ac, the following simplified equation shall be used for determining the required TN concentration allowed for a specific lot size: total nitrogen concentration (in mg/l) = [lot size (in acres) / design flow (in gpd)] x 30,000. The concentration limit shall be based on a 6-~~quarter running~~ sample rolling average with no single sample exceeding twice of the concentration limit.

~~C. Where tertiary treatment is required, tertiary treatment shall be to 25 mg/L total nitrogen, or to the level based on the formula in 20.7.3.603.B, which ever is lower in concentration.~~

D. Tertiary treatment systems and the disposal from tertiary treatment systems shall meet the specific site conditions set forth in 20.7.3.605 NMAC.

Effluent Monitoring Frequency (proposed 901.B, C and D)

The parties agree to NMED's proposed frequency of quarterly for the first year, semi-annual for the second year, and annually thereafter.

20.7.3.901 MONITORING:

A. As a condition to any permit, the owner of a on-site liquid wastes system shall permit department personnel right of entry to the property at reasonable times to allow for effluent sampling or evaluating the general state of repair or function of the system.

B. On-site liquid waste systems that require secondary treatment levels be achieved shall be sampled and analyzed only for 5-day BOD quarterly for the first year, semi-annually for the second year, and yearly thereafter or as otherwise required by the department to meet the requirements of the permit. Chemical oxygen demand (COD) may be substituted for BOD5 with an acceptable calibration curve as approved by the department.

C. On-site liquid waste systems that require tertiary treatment levels be achieved shall be sampled and analyzed only for total nitrogen quarterly for the first year, semi-annually for the second year, and yearly thereafter or as otherwise required by the department to meet the requirements of the permit.

D. Advanced systems requiring disinfection shall be sampled and analyzed for fecal coliform quarterly for the first year, semi-annually for the second year, and yearly thereafter or as otherwise required by the department.

Water Softener Regeneration Waste (proposed 201)

NMED met with representatives of the water softening industry and the parties agreed on the following provisions:

- Water softener waste would continue to be discharged to conventional systems without restriction.

- Water softener waste would not be allowed to be discharged into ATUs at new homes being constructed. The waste would have to either bypass the ATU and discharge directly to the drainfield, or be disposed of in some other manner.
- If a water softener is to be installed at an existing home with an ATU, the LW permit would have to be modified, written notice would have to be given to the ATU maintenance provider, and either a DIR softener or ATU bypass would have to be installed.
- If an ATU is to be installed at an existing home with a water softener, installation would be done in accordance with the LW permit issued by NMED.

20.7.3.201

S. Waste from a water softener unit shall comply with the following:

(1) Softener waste may be discharged to a conventional treatment unit.

(2) For new construction utilizing an advanced treatment unit, the softener waste shall not be discharged to the advanced treatment unit. The softener waste shall bypass the advanced treatment unit and discharge directly to the drainfield or be disposed of in some other manner acceptable to the department.

(3) If a water softener unit is installed at an existing residential or commercial unit utilizing an advanced treatment unit:

(a) the current liquid waste permit shall be amended to reflect the installation;

(b) a written notice shall be submitted to the maintenance service provider of the advanced treatment unit; and,

(c) either a demand-initiated regeneration control device (DIR device) shall be installed or the softener waste shall bypass the advanced treatment unit.

(4) If an advanced treatment unit is to be installed at an existing residential or commercial unit with an existing water softener, the installation shall be done in accordance with the permit.

RV Waste (proposed 201.J)

NMED met with representatives of the RV campground industry and the parties agreed on the following provisions:

- Existing LW systems receiving RV waste would be grandfathered.
- Pretreatment of RV waste, as approved by NMED, would be required for new LW systems, existing systems that do not presently receive RV waste, or for existing systems where RV design flows increase.

20.7.3.201

J. ~~Recreational vehicle (RV) dump stations shall be connected to a non-discharging system that is designed to receive and does receive 2000 gallons per day or less.~~

On-site liquid waste systems receiving waste from recreational vehicles (RVs), other than holding tanks, shall provide pretreatment of the waste to the level of domestic waste as defined in Paragraph (6), Subsection D of 20.7.3.7 NMAC. Existing on-site liquid waste systems receiving waste from recreational vehicles shall continue to be authorized to operate. Upon modification of these existing systems, the system shall be required to provide pretreatment of the waste.

Septic Tank Additives (proposed 304.D)

NMED withdraws its proposal to completely prohibit the use of additives on the basis that, while there is little evidence that any of these products actually benefit liquid waste systems, most such products probably do no harm. Products that contain potentially harmful solvents, as have been marketed in New Mexico in the past, would be controlled pursuant to the existing prohibition on the introduction of solvents and other hazardous materials (308 existing, 304 relocated). POWRA proposes to prohibit additives to ATUs only.

20.7.3.304 STANDARDS; PROHIBITIONS:

A. No person shall introduce into an on-site liquid waste system household hazardous wastes, solvents, fertilizers, livestock wastes, or other materials of a composition or concentration not generally considered liquid waste as defined in 20.7.3 NMAC.

~~B. Wastes from recreational vehicle holding tanks and portable toilets shall not be discharged into a conventional on-site liquid waste system, except of noted in Subsection E of 20.7.3.809 NMAC.~~

~~C. Wastes from water softeners shall not be discharged into an on-site liquid waste system.~~

~~D. Liquid waste treatment additives shall not be used.~~

B. Liquid waste treatment additives shall not be used as a means to reduce the frequency of proper maintenance and removal of septage from a treatment unit. (This is the language in the current regulation.) Additives shall not be introduced into an on-site treatment system utilizing advanced treatment units unless otherwise allowed by the treatment unit manufacturer. (Proposed by POWRA)

Gravel Tickets

The parties agree that the Liquid Waste Inspection Form will be modified to include a signature box for installers to certify that the system was installed in accordance with the permit approved by NMED.

Inspection Reports

The parties agree that certified inspectors should be required to file inspection reports for all inspections, whether completed or not.

The following is new proposed language.

20.7.3.902 OPERATION AND MAINTENANCE REQUIREMENTS AND INSPECTION REQUIREMENTS AT TIME OF TRANSFER:

E. In the event of a failed system, that includes, but is not limited to disposal fields, the owner shall remedy the failed system with Department approval.

Testimony of
NMED Environmental Health Division
Before the Environmental Improvement Board
January 3, 2007

Liquid Waste Disposal and Treatment Regulations

Process and Procedures Used in Development of Regulations

In 2005, the Environmental Health Division of the Environment Department (Collectively the Division) came before this Board to make significant changes to the Liquid Waste Disposal and Treatment Regulations. Those regulations became effective in September of 2005. Since that time, the Division has gained experience with the new regulations, and is now proposing amendments for their improvement and clean-up. On March 2, 2006 all persons on the EIB and Liquid Waste Program mailing lists were sent a letter giving them the opportunity to participate in and provide comments and recommendations to any part of the liquid waste regulations. On April 28, 2006 the Liquid Waste Program compiled a summary of proposed amendments received by interested stakeholders and sent it out to all interested parties as a result of the Division's March 2, 2006. All persons on the EIB and Liquid Waste Program mailing lists were also sent notices regarding public meetings that were held on May 3, 2006 and July 25, 2006 in Albuquerque to discuss proposed amendments that were complied in the Division's April 28, 2006 Summary of Proposed Amendments. The proposed changes that the Division is proposing were posted on the Liquid Waste Program web page since August 22, 2005.

Impact of Regulations on Affected Entities and Public

The Environmental Health Division is proposing several amendments to the Liquid Waste Disposal and Treatment Regulations. These amendments are expected to improve the practical application of the regulations, making them more "user friendly." Tab A to this filing sets forth the proposed amendments with particularity and Mr. Brian Schall will provide testimony on the specific proposed changes.

Time line Analysis & Effective Date

The amendments will provide clarification and improve the effectiveness of the proposed regulations as soon as they become effective. It is anticipated that they can be filed with the state's record center soon after the Board issues a Statement of Reasons, and will be effective 30 days after filing.

Impact on Division Staff

The impact to Division staff will be to make the administration of the regulations better and clarify certain language so that multiple interpretations cannot be argued. Because several clarifications are being made, it is expected that the regulations will be easier to apply in a unified fashion throughout the State.

Identify and Address EJ Issues

The Liquid Waste Disposal and Treatment Regulations are designed to protect all people, regardless of race or income and to better insure that groundwater is better protected for all people in New Mexico.

Summary of Amendments

The following is a summary of amendments to the Liquid Waste Disposal and Treatment Regulations. Most of the changes are technical in nature, or are clarifications or minor word changes and are not opposed. Those that have opposition are noted, and will be addressed in a separate section on disputed issues.

20.7.3.7A(4)	Removed 'surface irrigation systems' from definition of "alternative disposal. Surface irrigation was removed during the previous rule change but the reference in the definition was overlooked. Whether surface irrigation should be an accepted method of alternative disposal is a disputed issue and will be more fully addressed in that section of the testimony.
20.7.3.7A(6)	Expanded the definition of "approved" to include a liquid waste system that permitted and installed in accordance with the regulations and persons or entities authorized by the department to perform activities on liquid waste systems. There are sections in the regulation that reference an approved system therefore the definition needed modified to encompass these references.
20.7.3.7C(2)	Added a definition for "certificate of registration". Sections of the regulations references a certificate of registration however the term is not defined.
20.7.3.7E(4)	Added a definition for "elevated system". Reference to elevated system is proposed in Section 807. This definition was added following the filing of the Division's request for hearing due to stakeholder input.
20.7.3.7E(6)	Currently Section 7E(5). Modified the definition of "established system" to include cesspools installed prior to Sept. 14, 1973.

	Prior to Sept. 14, 1973, cesspools were a recognized means of disposal.
20.7.3.7L(2)	Removed Type Ia and Type IV soils from the definition of "limiting layer". Table 703.1 lists application rates for Type Ia and VI soils, thus these soils types are not limiting.
20.7.3.7M(5)	Consolidated and simplified the definition of "modify".
20.7.3.7S(13)	Removed reference to soil types from the definition of "suitable soil". Table 703.1 lists application rates for all soil types, thus all soil types are suitable for disposal.
20.7.3.201H	Reduced the size of the replacement area from 100% to 50%. Added that for drip systems, a replacement area is not required. As the size of drainfields increased, it has become harder to meet the requirement for 100% replacement area. And as the drainfields size increases, the frequency of failures should decrease. Requiring some replacement/reserve area allows for the addition of drainfield if the design flows increase. Though originally disputed by the Homebuilders Association, we believe that a compromise has been reached for now, and this is no longer disputed.
20.7.3.201L	Modified the language dealing with existing systems and regulations in effect at the time of installation to include "the current regulations, whichever is less stringent". There are instances where the current regulation may be less stringent than a prior regulation.
20.7.3.201N	Add clarifying language dealing with 'Letter of Determination'. The general findings in a Letter of Determination do not supersede the actual site specific requirements.
20.7.3.201R(1)	Language added stating that water softener waste not discharged to a conventional treatment unit may be discharged in accordance with other applicable regulations. The current regulation states that softener discharge 'may' be discharged to a conventional system. Therefore, the discharge may be discharged in an alternative manner and that discharge must not be contrary to other applicable requirements. The change supported by the Department is a clarification and is not opposed. Whether water softener waste should be allowed in conventional treatment units is a disputed issue raised by POWRA and will be discussed in the section on disputed issues.

20.7.3.201R(2)	Language added language stating that the discharge of water softener waste must meet all other state and local regulations. Reasoning the same as above.
20.7.3.202A	Added language that states that this section deals with both permitted and un-permitted systems. Also, clarifies that only that portion of the system being modified needs to meet current standards. The current regulation is confusing when dealing with the modification of an unpermitted system. This language will eliminate that confusion. The modified language also clarifies that only the portion of the system that is being modified needs to be brought up to current requirements.
20.7.3.202E	Deleted original language and added new language stating that upon the issuance of a modification permit and subsequent approval of the construction, a previously un-permitted system shall become permitted.
20.7.3.203	Added 'Construction' to title for clarification. The change is to clarify that this section deals with inspections conducted for the construction of the system, not for property transfers.
20.7.3.203A	Added sentence clarifying under what conditions test holes may not be required. The current regulation is confusing as to when test holes are required or when they are not.
20.7.3.203B(2)	Moved to this section the requirement that all homeowner installed systems be inspected. This is currently found in the permitting section.
20.7.3.301C	Corrected an oversight in the current regulations dealing with easements and lot size.
20.7.3.301I	Added language that states that if a lot is reduced in size to the point that it no longer meets the required lot size, the existing permit shall be voided.
20.7.3.301J	Added language that states if a lot is reduced in size but it still meets the required lot size, the permit shall be amended to reflect the new lot size.
20.7.3.302A	Changes made to Table 302.1 to correct discrepancy in setbacks from seepage pits. Current regulations states the setback from a disposal field to a seepage pit is 10 feet, but the setback from a seepage pit to the disposal field is 5 feet.

20.7.3.401C	Removed the language requiring all homeowner installed systems be inspection from this section and moved it to the section on inspections. Moved this language to the section on inspections.
20.7.3.401J(1)	Added language for clarification purposes that states the treatment unit needs to meet the requirements in effect at the time of installation and the inspection is conducted using an approved form. Some septic tanks may not meet the current requirements but met the requirements at the time of their initial installation and are still functioning properly.
20.7.3.401K	Updated language in paragraph (1) to be consistent with language in Department's policy on this subject. Also separated paragraph (3) into two paragraphs for clarification. The current language is too generalized and un-workable in the field. The proposed language is more specific as to the steps that need to be taken.
20.7.3.403E	Added clarifying language requiring an amendment of permit to reflect ownership change upon transfer of property. The proposed language provide for the need to submit the proper form for the change of ownership to occur.
20.7.3.405B	Changed notification requirements for the variance process. The current requirements are too burdensome. The Department found that the current language, especially in high density areas, created a hardship on the applicant.
20.7.3.501B	Added language stating the treatment units must meet the regulation requirements. The proposed language clarifies what standards need to be met for approval.
20.7.3.601	Changed the wording to remove confusion with the terminology "ATU". In the industry language, ATU means 'aerobic treatment unit' not to be confused with an 'advanced treatment system'.
20.7.3.601D	Change in language for reasons stated above.
20.7.3.601E	Added new language requiring a sampling port on advanced treatment systems. Without the ability to obtain a representative effluent sample, the ability to monitor properly is compromised.
20.7.3.605B(3)	Changed required treatment level to primary treatment to match Table 703.1 and added language stating disposal shall be by an appropriate, approved method.

20.7.3.605C	Changed depth of suitable soil to 1 to 4 feet requiring secondary treatment and disinfection and required at least one foot of suitable soil to a limiting layer.
20.7.3.605D	Corrected grammar.
20.7.3.701D	Language added allowing inspections ports to be located below ground in a protected, locatable enclosure. Installation below ground will protected the inspection ports from damage. This language was added after the Division filed its request for hearing to take care of an issue identified by a stakeholder.
20.7.3.701E	Removed reference to needing variance for seepage pit and changed setback from seepage pit to a trench to match requirement listed in Table 302.1.
20.7.3.701F	Clarified and rearranged language dealing with headers to multiple trenches instead of a D-box.
20.7.3.701H	Increased length of trench to 155 foot to accommodate the length of certain proprietary products. Changed amount of aggregate under drain line to match requirement in Subsection 703J.
20.7.3.702	Removed requirement that seepage pits shall require a variance for installation.
20.7.3.703B	Language change to clarify that test holes may be required but are not always required to bring this section into agreement with Subsection 203A.
20.7.3.703F	Removed restriction on conventional systems in Type IV soils to match requirements in Table 703.1.
20.7.3.703G	Modified language dealing with appropriate disposal options. The proposed language brings this section in line with changes to other sections dealing with Type IV soils.
20.7.3.703J(6)	Change requirement for minimum bottom area to a minimum total absorption area. The minimum area is equal to that required for a one-bedroom house.
20.7.3.801	Removed reference to 'surface application' as an alternative disposal method. This is a disputed issue and will be addressed separately as a disputed issue.

20.7.3.803D	Clarified language dealing with the responsibility for operation and maintenance of cluster systems.
20.7.3.805A	Simplification of existing language dealing with the treatment level for the use of effluent for irrigation.
20.7.3.805J	Added less restrictive requirements for setbacks for irrigation systems to property lines and buildings. The current 5-foot setback eliminates the landscape areas that normally require irrigation.
20.7.3.807C	Added language allowing other approved designs in lieu of the Wisconsin design.
20.7.3.807E & F	Removed subsections since they duplicate what is require in design manual previously referenced.
20.7.3.807E, F & G	Added specific language dealing with the installation of an elevated system. This language was added after the Division's request for hearing was filed, due to stakeholder input.
20.7.3.811A	Remove restriction that gray water systems shall only be installed on 'single family' residential units, thus allowing the use of graywater on multiple family units, such as condos.
20.7.3.902E	Removed language stating items needed to be performed for an inspection and replaced with requiring the use of the Department approved form, which is more encompassing that the current requirements. Also added language requiring the sampling of advance treatment systems if the sampling schedule is not up to date.
20.7.3.902E(3)	Replaced the language requiring corrective action be completed in 15 days to requiring the submittal of an application within 15 days. The submittal of the application initiates the corrective action and permit conditions can set up a more realistic time frame.
20.7.3.904A	Extended the date that individuals need to be certified until 2009 to allow time for training and testing. Once the certification programs are developed; there is a time frame needed to allow the affected individuals to complete the certification process.
20.7.3.907	Added language 'after due process is provided'.

Disputed Issues

The amendments being proposed by the Environmental Health Division are for the most part minor technical amendments, and are not controversial. However, at the final stakeholder meeting on July 25, 2006, the parties "agreed to disagree" on five issues:

1. surface application of liquid waste;
2. water softener waste restrictions;
3. administrative penalties for unpermitted systems installed on or after February 1, 2002;
4. drainfield replacement area; and
5. drainfield surge capacity.

1. Surface Application (20.7.3.7.A.4 and 801)

NMED has proposed to eliminate all surface application of liquid waste except as approved by variance. The reasons for this proposed amendment are as follows:

a. surface application can create hazards to public health if a failure of the treatment system occurs;
b. disinfection systems have not always been properly maintained on surface application systems that have been permitted in the past.

2. Water Softener Waste (20.7.3.201.R)

The existing Liquid Waste Regulations contain restrictions on the disposal of water softener waste into advanced treatment systems. NMED also has the authority to impose more stringent requirements, if necessary, to restrict the discharge of water softener waste into conventional systems as well. POWRA has proposed additional restrictions on the disposal of water softener waste into liquid waste systems on a statewide basis. NMED does not believe that sufficient data presently exist to support this proposed restriction.

3. Administrative Penalties for Unpermitted Systems Installed on or after February 1, 2002 (20.7.3.401.K)

The N.M. Environmental Improvement Act § 74-1-10 provides that the NMED Secretary "may" issue a compliance order assessing a civil penalty for any past or current violation of the Liquid Waste Regulations. As currently written, regulation 20.7.3.401.K.3 provides for a mandatory administrative penalty, which requires issuance of a compliance order as prescribed by law. This discrepancy between the statute and regulations is addressed by Liquid Waste Program Guidance #8 (copy attached, TAB C). NMED proposes to amend the regulation to make penalty assessment discretionary, in accordance with the statute.

4. Drainfield Reserve/Replacement Area (20.7.3.201.H)

NMHBA proposed to eliminate the requirement for an unobstructed drainfield reserve/replacement area equivalent to 100% of the required original disposal system. NMED and NMHBA have agreed to reduce the required reserve/replacement area to 50%.

5. Drainfield Surge Storage Capacity (20.7.3.7.A.1, 703.J.2 and 703.J.4)
The issue of absorption area was discussed extensively during the regulation amendment proceedings of 2004-05. Two national drainfield experts were brought in for a special Wastewater Technical Advisory Committee meeting on drainfield sizing. Both experts identified surge storage capacity as a necessary safety factor for drainfield design, and recommended a capacity of 12 to 18 inches below the invert of the drain pipe. After further discussion, however, NMED and other parties agreed to reduce the surge capacity from twelve to six inches, and six inches was adopted by the EIB. POWRA proposes to eliminate the six inches of surge capacity and calculate absorption area starting at the bottom of the invert of the drain pipe. NMED opposes the POWRA proposal on the basis that it offers no protection for surge capacity, and is contrary to the advice of the national experts who were consulted on this issue.

Effect on Small Business

The amendments to the Liquid Waste Disposal and Treatment Regulations are not expected to adversely affect small businesses. For the most part, the regulations apply to households.

STATE OF NEW MEXICO
BEFORE THE ENVIRONMENTAL IMPROVEMENT BOARD

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MAY 2007
Received
Environmental Improvement Board

IN THE MATTER OF
PROPOSED AMENDMENTS
TO LIQUID WASTE DISPOSAL
AND TREATMENT REGULATIONS
20.7.3 NMAC EIB No. 06-06(R), 06-07(R), 06-13(R)

NEW MEXICO ENVIRONMENT
DEPARTMENT,

Petitioner.

ORDER AND STATEMENT OF REASONS
FOR AMENDMENT OF REGULATIONS

THIS MATTER comes before the New Mexico Environmental Improvement Board ("Board") upon a petition filed by the Environmental Health Division ("Division") of the New Mexico Environment Department ("NMED" or "Petitioner") and the Professional On-Site Wastewater Re-Use Association of New Mexico Inc., ("POWRA") and the New Mexico Homebuilders Association proposing amendments to 20.7.3 NMAC. The New Mexico Homebuilders Association subsequently withdrew its petition and concurred with NMED's petition. A public hearing was held in Santa Fe, New Mexico on January 3-5, 2007, with a quorum of the Board present during the hearing. The Board heard technical testimony from Petitioner and POWRA and admitted exhibits into the record. Infiltrator Systems Inc submitted technical testimony. The Board also heard non-technical testimony. On January 5, 2007, the Board deliberated and voted unanimously to adopt the amendments set forth below in relevant part, for the reasons that follow.

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Sheehan, Sheehan, & Stelzner, P.A.

I. AMENDMENTS

The Amendments were to the Liquid Waste and Disposal Regulations (Title 20, Chapter 7, Part 3) as proposed by the NMED and adopted by the Board at its January 5, 2007 meeting. *See* NMED's Exhibit # A.

II. STATEMENT OF REASONS

1. NMED filed its Petition for Public Hearing to Consider Proposed Amendments to Title 20, Chapter 7, Part 3 of the New Mexico Administrative Code ("NMAC") on August 21, 2006 under EIB 06-06(R).
2. POWRA filed its Petition for Public Hearing on August 22, 2006 under EIB 06-07(R).
3. New Mexico Homebuilders filed its Request for Public Hearing on September 19, 2006 under EIB 06-13(R).
4. The Board met on September 7, 2006, and scheduled a hearing in this matter.
5. Notice of the Public Comment Period and Hearing for the proposed amendments was published in the New Mexico Register on October 31, 2006. *See* NMED's Exhibit #D.
6. Notice of the Public Comment Period and Hearing for the proposed amendments was published in the Albuquerque Journal on October 29, 2006. *See* NMED's Exhibit #D.
7. A Notice of Intent to Present Technical Testimony was filed by NMED on December 19, 2006.
8. A Notice of Intent to Present Technical Testimony was filed by POWRA on December 19, 2006.

9. A Notice of Intent to Present Technical Testimony was filed by Infiltrator Systems Inc. on December 19, 2006.

10. A hearing was convened in this matter on January 3-5, 2007, in Santa Fe, New Mexico.

11. Ms. Ana Marie Ortiz, Division Director, Mr. Dennis McQuillan, Liquid Waste Manager, Mr. R. Brian Schall, Environmental Specialist provided oral and written technical testimony at the hearing in support of the amendments. Ms. Ortiz gave an overview, Mr. Schall testified about the proposed changes, and Mr. McQuillan testified about disputed issues.

12. NMED witnesses provided oral and written testimony explaining the proposed changes on a section-by-section basis. *See* NMED's Exhibit #B.

13. NMED witnesses provided oral and written testimony explaining most of the proposed changes were clean-up language, clarifications or minor word changes, and were not contested during the hearing. *See* NMED's Exhibit #B.

14. The Board adopted these changes for these reasons stated in NMED's testimony.

15. NMED witnesses provided oral and written testimony explaining that several of its changes overlapped or were similar to POWRA's proposed changes and provided clarity to the regulations. These sections included, but were not limited to, in Sections 20.7.3.7E, 20.7.3.807, 20.7.3.808I(2), and 20.7.3.904A NMAC.

16. Mr. Eugene Bassett, Link Summers, and Mr. Dave Gustafson provided oral testimony explaining POWRA's proposed changes.

17. The Board adopted NMED's changes for the sections where the proposed changes were similar, provided clarity to the regulations, and the parties appeared willing to accept the language.

18. The Board adopted POWRA's changes for a portion of Section 20.7.3.808 regarding "except for mound systems" and all of 20.7.3.904 NMAC since the proposed changes were similar, provided clarity to the regulations, and the parties appeared willing to accept the language.

19. NMED and POWRA did have several contested areas presented in NMED's and POWRA's proposals.

20. Infiltrator Systems, Inc. witness Mr. Dennis Hallahan, P.E. provided oral testimony on the design and function of drainfields, trenches, and beds, including the infiltration of wastewater through drainfields, trenches, and beds, and the appropriate loading rates for drainfields, trenches, and beds.

21. Mr. Schall, Mr. McQuillan and Mr. Hallahan's testimony established grounds for NMED's position regarding the issue of "Surge Storage Capacity" in 20.7.3.7.A(1) and 20.7.3.703.J NMAC: (a) the Board had previously adopted the six inch measurement; (ii) the six inch measurement is an important safety factor for the whole equation; (iii) the six inch measurement is on par and comparable with other states; (iv) a zero inch measurement appears to be too low of a figure; (v) the lack of health problems refutes the argument that the current measurement lacks merit; (vi) cost and economic concerns should be weighed (with the approximate $500-$1,000 extra expense at the six inch measurement) but environmental and human health protection outweigh these cost concerns; (vii)

the six inch measurement was a negotiated figure by stakeholders at a previous Board rule-making hearing and (viii) this rule-making hearing was intended to clean-up the regulations and not to re-open major stakeholder issues.

22. Mr. Schall and Mr. McQuillan's testimony established grounds for NMED's position regarding the issue of "Surface Application" in 20.7.3.7.A(4) and 20.7.3.801 NMAC: (i) the deletion of surface irrigation systems was appropriate because an applicant can still request that process via a variance; (ii) a variance gives an extra level of protection and safety to the public and the environment; (iii) these systems can be installed correctly, but should be an option of last resort.
23. Mr. Schall and Mr. McQuillan's testimony established grounds for NMED's position regarding the issue of "Administrative Penalties" in 20.7.3.201.C NMAC: (i) NMED testified that POWRA's change was not necessary because it was already addressed in the regulations; (ii) there is difference between a permitted system and a final inspection; (iii) the term "final inspection" could be misinterpreted as a blanket term; (iv) POWRA's language may require NMED to physically inspect every approved permit and this could be unfairly onerous and not cost-effective; (v) NMED may have a lack of manpower, logistical power, and budget to approve all materials and document all materials going into every tank and physically inspect every approved permit; (vi) the punitive disciplinary process, via a Compliance Order, is already set in statute and cannot be superseded by a Board regulation.
24. Mr. Jeffrey Vinyard, Southwest Water Conditioning, Inc., and Water Quality Association, provided oral and written public testimony regarding the "Water

Softener Waste" issue. Mr. Pete Oswald, Mr. Lonnie Bellon, and Mr. David Loveday provided public comment regarding the "Water Softener Waste" issue.

25. Mr. Schall, Mr. McQuillan, Mr. Oswald, and Mr. Vinyard's testimony established grounds for NMED's position regarding the issue of "Water Softener Waste" in 20.7.3.201.R NMAC: (i) it may be appropriate to wait until the national study on this issue is finalized; (ii) cost and economic concerns should be weighed and POWRA's proposal may put some water softener companies out of business; (iii) rural New Mexicans use water softeners for their drinkable water and eliminating this drinking option may harm rural New Mexicans, which may implicate environmental justice issues; and (iv) today's rule-making hearing was intended to clean-up the regulations and not to re-open major stakeholder issues.
26. There was public comment raising concern about licensees making false claims and advertisement in newspapers. NMED counsel noted that this issue involves the state Unfair Trade Practices Act and should be referred to the state Attorney General's office and not handled by Board rule.
27. POWRA raised a couple of future-looking issues, such as new regulations on waterless urinals that NMED staff testified were interesting and worth examining at a future date.
28. Pursuant to NMSA 1978, Section 74-1-9(B)(1) the Board shall weigh interference with health and welfare and the Board concluded that having a comprehensive liquid waste system regulatory system was beneficial to the health and welfare of citizens.

29. Pursuant to NMSA 1978, Section 74-1-9(B)(2) the Board shall weigh the economic value of the regulated activity and social effects of environmental effects of environmental degradation and the Board concluded: (a) that liquid waste system businesses were important and proposed changes would provide greater clarity to the regulations; (b) the proposed changes maintain the emphasis on preventing environmental degradation and public health, but attempt to consider and balance the costs to the businesses; and (c) POWRA's proposed change would appear to greatly interfere with the water softener business.

30. Pursuant to NMSA 1978, Section 74-1-9(B)(3) the Board shall weigh the technical practicability of any proposed changes and the Board concluded that since this hearing was for clean-up matters the proposed amendments were not intended to raise issues about technical practicability regarding surge storage capacity and water softener issues at this time.

31. The Board has authority to modify a petition because "even substantive changes in the original plan may be made so long as they are in character with the original scheme and a logical outgrowth of the notice and comment already given." BASF Wyandotte Corp., et al. v. Costle, 598 F. 2d 637, 642 (1st Cir. 1979), cert. denied, 444 U.S. 1086 (1980).

32. Pursuant to the Small Business Regulatory Relief Act, NMED noted "amendments to the Liquid Waste Disposal and Treatment Regulations are not expected to adversely affect small businesses. For the most part, the regulations apply to households" would not have an adverse impact on small businesses. *See* NMED's Exhibit #B.

33. In overall conclusion, NMED had the authority to bring this petition.

34. The Board has the authority to approve this petition.

35. NMED's petition satisfies all applicable procedural requirements.

36. NMED's testimony satisfies the statutory requirements of NMSA 1978, Sections 74-1-8.

37. Therefore, the regulations are adopted for any or all of the reasons stated above.

III. ORDER:

By a unanimous vote, the petition was approved on January 5, 2006. The proposed amendments to the Liquid Waste Disposal and Treatment Regulations as set forth in Exhibit A, with the POWRA's language in 20.7.3.808.I(2) and 20.7.3.904 NMAC, with any appropriate corrections of typographical errors, formatting or other changes necessary to file this rule with the New Mexico State Records Center, are hereby adopted, to be effective 30 days after filing with the State Records Center.

Gay Dillingham

On behalf of the Board

Dated: 5-1-07

EPA/625/R-00/008
February 2002

Onsite Wastewater Treatment Systems Manual

Office of Water
Office of Research and Development
U.S. Environmental Protection Agency

Chapter 4
Treatment processes and systems

4.1 Introduction

This chapter contains information on individual onsite/decentralized treatment technologies or unit processes. Information on typical application, design, construction, operation, maintenance, cost, and pollutant removal effectiveness is provided for most classes of treatment units and their related processes. This information is intended to be used in the preliminary selection of a system of treatment unit processes that can be assembled to achieve predetermined pollutant discharge concentrations or other specific performance requirements. Complete design specifications for unit processes and complete systems are not included in the manual because of the number of processes and process combinations and the wide variability in their application and operation under various site conditions. Designers and others who require more detailed technical information are referred to such sources.

Chapter 4 is presented in two main sections. The first section contains information about *conventional* (soil-based or subsurface wastewater infiltration) systems, referred to as SWISs in this document. Both gravity-driven and mechanized SWISs are covered in this section of chapter 4. The second section contains a general introduction to sand filters (including other media), and a series of fact sheets on treatment technologies, *alternative* systems (e.g., fixed-film and suspended growth systems, evapotranspiration systems, and other applications), and special issues pertaining to the design, operation, and maintenance of onsite wastewater treatment systems (OWTSs). This approach was used because the conventional system is the most economical and practical system type that can meet performance requirements in many applications.

The first section is further organized to provide information about the major components of a conventional system. Given the emphasis in this manual on the design boundary (performance-based) approach to system design, this section was structured to lead the reader through a discussion of system components by working backwards from the point of discharge to the receiving environment to the point of discharge from the home or other facility served by the onsite system. Under this approach, soil infiltration issues are discussed first, the distribution piping to the infiltration system including graveless sytems is addressed next, and matters related to the most common preliminary treatment device, the septic tank, are covered last.

The fact sheets in the second section of this chapter describe treatment technologies and discuss special issues that might affect system design, performance, operation, and maintenance. These treatment technologies are often preceded by a septic tank and can include a subsurface wastewater infiltration system. Some treatment technologies may be substituted for part or all of the conventional system, though nearly all alternative approaches include a septic tank for each facility being served. Fact sheets are provided for the more widely used and successful treatment technologies, such as sand filters and aerobic treatment units.

The component descriptions provided in this chapter are intended to assist the reader in screening components and technologies for specific applications. Chapter 5 presents a strategy and procedures that can be used to screen and select appropriate treatment trains and their components for specific receiver sites. The reader should review chapter 5 before selecting system components.

4.2 Conventional systems and treatment options

The three primary components of a conventional system (figure 4-1) are the soil, the subsurface wastewater infiltration system (SWIS; also called a leach field or infiltration trench), and the septic tank. The SWIS is the interface between the engineered system components and the receiving ground water environment. It is important to note that the performance of conventional systems relies primarily on treatment of the wastewater effluent in the soil horizon(s) below the dispersal and infiltration components of the SWIS. Information on SWIS siting, hydraulic and mass loadings, design and geometry, distribution methods, and construction considerations is included in this chapter. The other major component of a conventional system, the septic tank, is characterized by describing its many functions in an OWTS.

Treatment options include physical, chemical, and biological processes. Use of these options is determined by site-specific needs. Table 4-1 lists common onsite treatment processes and methods that may be used alone or in combination to assemble a treatment train capable of meeting established performance requirements. Special issues that might need to be addressed in OWTS design include treatment of high-strength wastes (e.g., biochemical oxygen demand and grease from schools and restaurants), mitigation of impacts from home water softeners and garbage disposals, management of holding tanks, and additives (see related fact sheets).

4.3 Subsurface wastewater infiltration

Subsurface wastewater infiltration systems (SWISs) are the most commonly used systems for the treatment and dispersal of onsite wastewater. Infiltrative surfaces are located in permeable, unsaturated natural soil or imported fill material so wastewater can infiltrate and percolate through the underlying soil to the ground water. As the wastewater infiltrates and percolates through the soil, it is treated through a variety of physical, chemical, and biochemical processes and reactions.

Many different designs and configurations are used, but all incorporate soil infiltrative surfaces that are located in buried excavations (figure 4-1). The primary infiltrative surface is the bottom of the excavation, but the sidewalls also may be used for infiltration. Perforated pipe is installed to distribute the wastewater over the infiltration surface. A porous

Figure 4-1. Conventional subsurface wastewater infiltration system

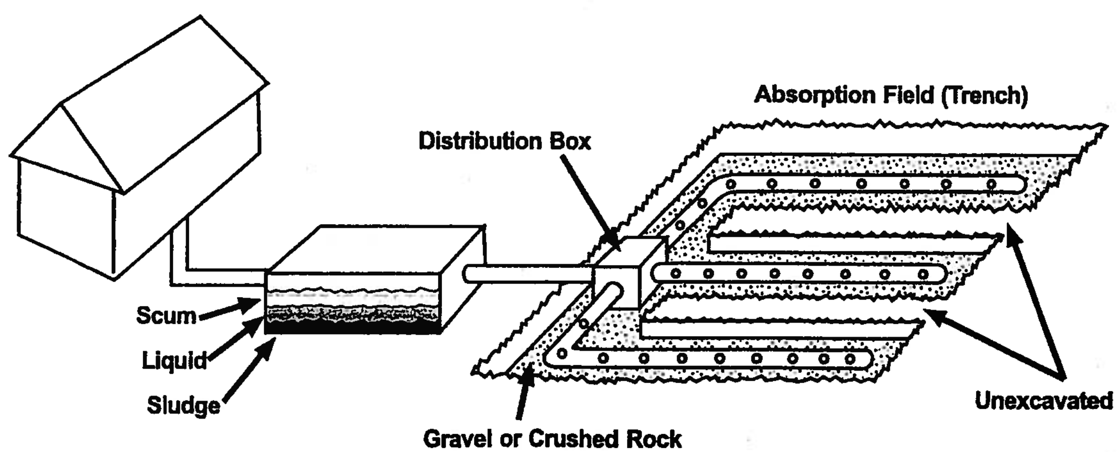


Table 4-1. Commonly used treatment processes and optional treatment methods

Treatment objective	Treatment process	Treatment methods
Suspended solids removal	Sedimentation	Septic tank Free water surface constructed wetland Vegetated submerged bed
	Filtration	Septic tank effluent screens Packed-bed media filters (incl. dosed systems) Granular (sand, gravel, glass, bottom ash) Peat, textile Mechanical disk filters Soil infiltration
Soluble carbonaceous BOD and ammonium removal	Aerobic, suspended-growth reactors	Extended aeration Fixed-film activated sludge Sequencing batch reactors (SBRs)
	Fixed-film aerobic bioreactor	Soil infiltration Packed-bed media filters (incl. dosed systems) Granular (sand, gravel, glass) Peat, textile, foam Trickling filter Fixed-film activated sludge Rotating biological contactors
	Lagoons	Facultative and aerobic lagoons Free water surface constructed wetlands
Nitrogen transformation	Biological Nitrification (N) Denitrification (D)	Activated sludge (N) Sequencing batch reactors (N) Fixed film bio-reactor (N) Recirculating media filter (N, D) Fixed-film activated sludge (N) Anaerobic upflow filter (N) Anaerobic submerged media reactor (D) Submerged vegetated bed (D) Free-water surface constructed wetland (N, D)
	Ion exchange	Cation exchange (ammonium removal) Anion exchange (nitrate removal)
Phosphorus removal	Physical/Chemical	Infiltration by soil and other media Chemical flocculation and settling Iron-rich packed-bed media filter
	Biological	Sequencing batch reactors
Pathogen removal (bacteria, viruses, parasites)	Filtration/Predation/Inactivation	Soil infiltration Packed-bed media filters Granular (sand, gravel, glass bottom ash) Peat, textile
	Disinfection	Hypochlorite feed Ultraviolet light
Grease removal	Flotation	Grease trap Septic tank
	Adsorption	Mechanical skimmer
	Aerobic biological treatment (incidental removal will occur; overloading is possible)	Aerobic biological systems

medium, typically gravel or crushed rock, is placed in the excavation below and around the distribution piping to support the pipe and spread the localized flow from the distribution pipes across the excavation cavity. Other gravelless or "aggregate-free" system components may be substituted. The porous medium maintains the structure of the excavation, exposes the applied wastewater to more infiltrative surface, and provides storage space for the wastewater within its void fractions (interstitial spaces, typically 30 to 40 percent of the volume) during peak flows with gravity systems. A permeable geotextile fabric or other suitable material is laid over the porous medium before the excavation is backfilled to prevent the introduction of backfill material into the porous medium. Natural soil is typically used for backfilling, and the surface of the backfill is usually slightly mounded and seeded with grass.

Subsurface wastewater infiltration systems provide both dispersal and treatment of the applied wastewater. Wastewater is transported from the infiltration system through three zones (see chapter 3). Two of these zones, the infiltration zone and vadose zone, act as fixed-film bioreactors. The infiltration zone, which is only a few centimeters thick, is the most biologically active zone and is often referred to as the "biomat." Carbonaceous material in the wastewater is quickly degraded in this zone, and nitrification occurs immediately below this zone if sufficient oxygen is present. Free or combined forms of oxygen in the soil must satisfy the oxygen demand generated by the microorganisms degrading the materials. If sufficient oxygen is not present, the metabolic processes of the microorganisms can be reduced or halted and both treatment and infiltration of the wastewater will be adversely affected (Otis, 1985). The vadose (unsaturated) zone provides a significant pathway for oxygen diffusion to reaerate the infiltration zone (Otis, 1997, Siegrist et al., 1986). Also, it is the zone where most sorption reactions occur because the negative moisture potential in the unsaturated zone causes percolating water to flow into the finer pores of the soil, resulting in greater contact with the soil surfaces. Finally, much of the phosphorus and pathogen removal occurs in this zone (Robertson and Harman, 1999; Robertson et al., 1998; Rose et al., 1999; Yates and Yates, 1988).

4.3.1 SWIS designs

There are several different designs for SWISs. They include trenches, beds, seepage pits, at-grade systems, and mounds. SWIS applications differ in their geometry and location in the soil profile. Trenches have a large length-to-width ratio, while beds have a wide, rectangular or square geometry. Seepage pits are deep, circular excavations that rely almost completely on sidewall infiltration. Seepage pits are no longer permitted in many jurisdictions because their depth and relatively small horizontal profile create a greater point-source pollutant loading potential to ground water than other geometries. Because of these shortcomings, seepage pits are not recommended in this manual.

Infiltration surfaces may be created in natural soil or imported fill material. Most traditional systems are constructed below ground surface in natural soil. In some instances, a restrictive horizon above a more permeable horizon may be removed and the excavation filled with suitable porous material in which to construct the infiltration surface (Hinson et al., 1994). Infiltration surfaces may be constructed at the ground surface ("at-grades") or elevated in imported fill material above the natural soil surface ("mounds"). An important difference between infiltration surfaces constructed in natural soil and those constructed in fill material is that a secondary infiltrative surface (which must be considered in design) is created at the fill/natural soil interface. Despite the differences between the types of SWISs, the mechanisms of treatment and dispersal are similar.

4.3.2 Typical applications

Subsurface wastewater infiltration systems are passive, effective, and inexpensive treatment systems because the assimilative capacity of many soils can transform and recycle most pollutants found in domestic and commercial wastewaters. SWISs are the treatment method of choice in rural, unsewered areas. Where point discharges to surface waters are not permitted, SWISs offer an alternative if ground water is not closely interconnected with surface water. Soil characteristics, lot size, and the proximity of sensitive water resources affect the use of SWISs. Table 4-2 presents characteristics for typical SWIS applications and suggests applications to avoid. Local codes should be consulted for special requirements, restrictions, and other relevant information.

Table 4-2. Characteristics of typical SWIS applications

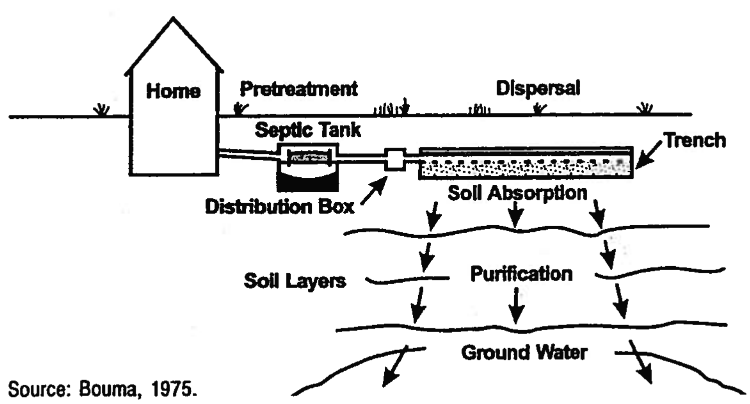
Characteristic	Typical application	Applications to avoid[a]
Type of wastewater	Domestic and commercial (residential, mobile home parks, campgrounds, schools, restaurants, etc.)	Facilities with non-sanitary and/or industrial wastewaters. Check local codes for other possible restrictions
Daily flow	< 20 population equivalents unless a management entity exists	> 20 population equivalents without a management program. Check local codes for specific or special conditions (e.g., USEPA or state Underground Injection Control Program Class V rule)
Minimum pretreatment	Septic tank, Imhoff tank	Discharge of raw wastewater to SWIS
Lot orientation	Loading along contour(s) must not exceed the allowable contour loading rate	Any site where hydraulic loads from the system will exceed allowable contour loading rates
Landscape position	Ridge lines, hilltops, shoulder/side slopes	Depressions, foot slopes, concave slopes, floodplains
Topography	Planar, mildly undulating slopes of ≤ 20% grade	Complex slopes of > 30%
Soil texture	Sands to clay loams	Very fine sands, heavy clays, expandable clays
Soil structure	Granular, blocky	Platy, prismatic, or massive soils
Drainage	Moderately drained or well drained sites	Extremely well, somewhat poor, or very poorly drained sites
Depth to ground water or bedrock	> 5 feet	< 2 feet. Check local codes for specific requirements.

[a]Avoid when possible.
Source: Adapted from WEF, 1990.

4.3.3 Typical performance

Results from numerous studies have shown that SWISs achieve high removal rates for most wastewater pollutants of concern (see chapter 3) with the notable exception of nitrogen. Biochemical oxygen demand, suspended solids, fecal indicators, and surfactants are effectively removed within 2 to 5 feet of unsaturated, aerobic soil (figure 4-2). Phosphorus and metals are removed through adsorption, ion exchange, and precipitation reactions. However, the retention capacity of the soil is finite and varies with soil mineralogy, organic content, pH, redox potential, and cation exchange capacity. The fate of viruses and toxic organic compounds has not been well documented (Tomson et al., 1984). Field and laboratory studies suggest that the soil is quite effective in removing viruses, but some types of viruses apparently are able to leach from SWISs to the ground water. Fine-textured soils, low hydraulic loadings, aerobic subsoils, and high temperatures favor destruction of viruses and toxic organics. The most significant documented threats to ground water quality from SWISs are nitrates. Wastewater nitrogen is nearly completely nitrified below properly operating SWISs. Because nitrate is highly soluble and environments favoring denitrification in subsoil are limited, little removal occurs (see chapter 3). Chlorides also leach readily to ground water because they, too, are highly soluble and are nonreactive in soil.

Figure 4-2. Lateral view of conventional SWIS-based system



Source: Bouma, 1975.

Dispersion of SWIS percolate in the ground water is often minimal because most ground water flow is laminar. The percolate can remain for several hundred feet as a distinct plume in which the solute concentrations remain above ambient ground water concentrations (Robertson et al., 1989, Shaw and Turyk, 1994). The plume descends in the ground water as the ground water is recharged from the surface, but the amount of dispersion of the plume can be variable. Thus, drinking water wells some distance from a SWIS can be threatened if they are directly in the path of a percolate plume.

4.4 Design considerations

Onsite wastewater treatment system designs vary according to the site and wastewater characteristics encountered. However, all designs should strive to incorporate the following features to achieve satisfactory long-term performance:

- Shallow placement of the infiltration surface (< 2 feet below final grade)
- Organic loading comparable to that of septic tank effluent at its recommended hydraulic loading rate
- Trench orientation parallel to surface contours
- Narrow trenches (< 3 feet wide)
- Timed dosing with peak flow storage
- Uniform application of wastewater over the infiltration surface
- Multiple cells to provide periodic resting, standby capacity, and space for future repairs or replacement

Based on the site characteristics, compromises to ideal system designs are necessary. However, the designer should attempt to include as many of the above features as possible to ensure optimal long-term performance and minimal impact on public health and environmental quality.

4.4.1 Placement of the infiltration surface

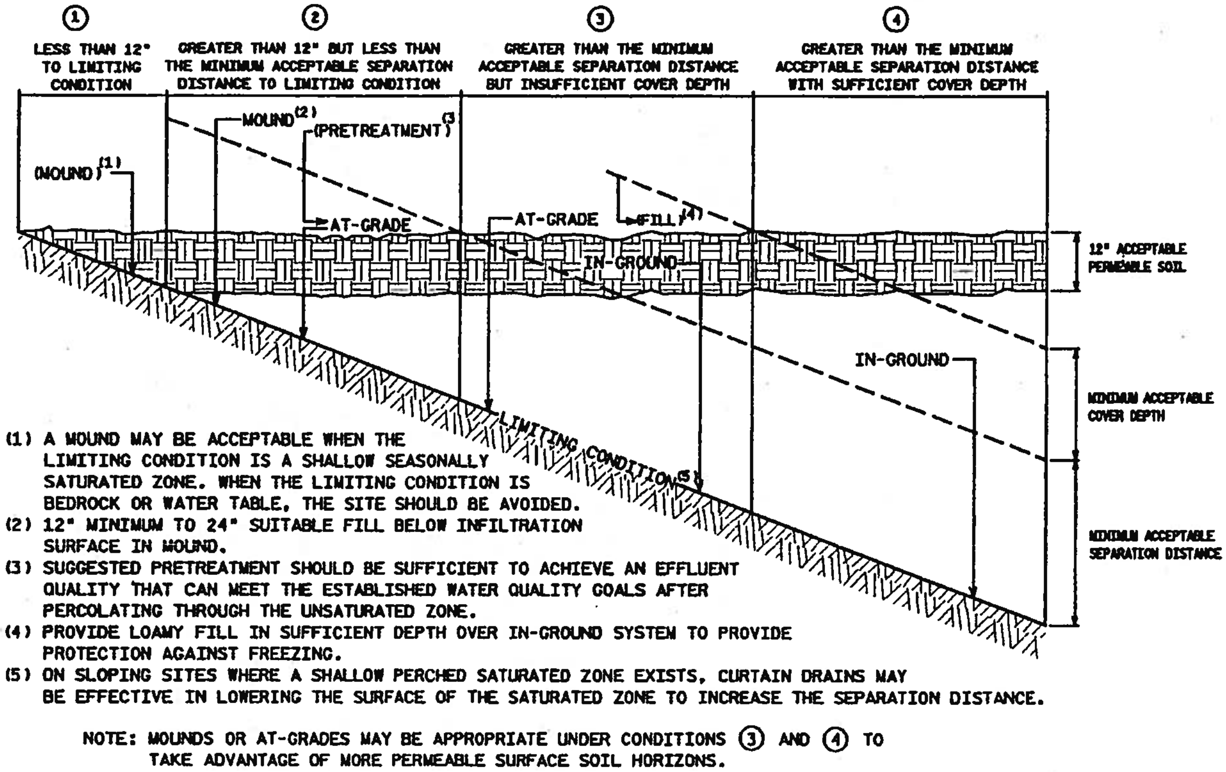
Placement of a SWIS infiltration surface may be below, at, or above the existing ground surface (in an in-ground trench, at grade, or elevated in a mound system). Actual placement relative to the original soil profile at the site is determined by desired separation from a limiting condition (figure 4-3). Treatment by removal of additional pollutants during movement through soils and the potential for excessive ground water mounding will control the minimum separation distance from a limiting condition. The depth below final grade is affected by subsoil reaeration potential. Maximum delivery of oxygen to the infiltration zone is most likely when soil components are shallow and narrow and have separated infiltration areas. (Erickson and Tyler, 2001).

4.4.2 Separation distance from a limiting condition

Placement of the infiltration surface in the soil profile is determined by both treatment and hydraulic performance requirements. Adequate separation between the infiltration surface and any saturated zone or hydraulically restrictive horizon within the soil profile (secondary design boundary as defined in section 5.3.1) must be maintained to achieve acceptable pollutant removals, sustain aerobic conditions in the subsoil, and provide an adequate hydraulic gradient across the infiltration zone. Treatment needs (performance requirements) establish the minimum separation distance, but the potential for ground water mounding or the availability of more permeable soil may make it advantageous to increase the separation distance by raising the infiltration surface in the soil profile.

Most current onsite wastewater system codes require minimum separation distances of at least 18 inches from the seasonally high water table or saturated zone irrespective of soil characteristics. Generally, 2- to 4-foot separation distances have proven to be adequate in removing most fecal coliforms in septic tank effluent (Ayres Associates, 1993). However, studies have shown that the applied effluent quality, hydraulic loading rates, and wastewater distribution methods can affect the unsaturated soil depth necessary to achieve acceptable wastewater pollutant removals. A few studies have shown that separation distances of 12 to 18 inches are sufficient to achieve good fecal coliform removal if the wastewater receives additional pretreatment prior to soil application (Converse and Tyler, 1998a, 1998b; Duncan et al., 1994). However, when effluents with lower organic and

Figure 4-3. Suggested subsurface infiltration system design versus depth (below the original ground surface) to a limiting condition



Source: Otis, 2001.

oxygen-demanding content are applied to the infiltration surface at greater hydraulic loading rates than those typically used for septic tank effluents (during extended periods of peak flow), treatment efficiency can be lost (Converse and Tyler, 1998b, Siegrist et al., 2000).

Reducing the hydraulic loading rate or providing uniform distribution of the septic tank effluent has been shown to reduce the needed separation distance (Bomblat et al., 1994; Converse and Tyler, 1998a; Otis, 1985; Siegrist et al., 2000; Simon and Reneau, 1987). Reducing both the daily and instantaneous hydraulic loading rates and providing uniform distribution over the infiltration surface can help maintain lower soil moisture levels. Lower soil moisture results in longer wastewater retention times in the soil and causes the wastewater to flow though the smaller soil pores in the unsaturated zone, both of which enhance treatment and can reduce the necessary separation distance.

Based only on hydraulics, certain soils require different vertical separation distances from ground water to avoid hydrologic interference with the infiltration rate. From a treatment standpoint, required separation distances are affected by dosing pattern, loading rate, temperature, and soil characteristics. Uniform, frequent dosing (more than 12 times/day) in coarser soils maximizes the effectiveness of biological, chemical, and physical treatment mechanisms. To offset inadequate vertical separation, a system designer can raise the infiltration surface in an at-grade system or incorporate a mound in the design. If the restrictive horizon is a high water table and the soil is porous, the water table can be lowered through the use of drainage tile or a curtain drain if the site has sufficient relief to promote surface discharge from the tile piping. For flat terrain with porous soils, a commercial system has been developed and is being field tested. It lowers the water table with air pressure, thereby avoiding any aesthetic concerns associated with a raised mound on the site. Another option used where the terrain is flat and wet is pumped drainage surrounding the OWTS (or throughout the subdivision) to lower the seasonal high water table and enhance aerobic conditions beneath the drainfield. These systems must be properly operated by certified operators and managed by a public management entity since maintenance of off-lot portions of the drainage network will influence performance of the SWIS.

The hydraulic capacity of the site or the hydraulic conductivity of the soil may increase the minimum acceptable separation distance determined by treatment needs. The soil below the infiltration surface must be capable of accepting and transmitting the wastewater to maintain the desired unsaturated separation distance at the design hydraulic loading rate to the SWIS. The separation distance necessary for satisfactory hydraulic performance is a function of the permeability of the underlying soil, the depth to the limiting condition, the thickness of the saturated zone, the percentage of rocks in the soil, and the hydraulic gradient. Ground water mounding analyses may be necessary to assess the potential for the saturated zone to rise and encroach upon the minimum acceptable separation distance (see section 5.4). Raising the infiltration surface can increase the hydraulic capacity of the site by accommodating more mounding. If the underlying soil is more slowly permeable than soil horizons higher in the profile, it might be advantageous to raise the infiltration surface into the more permeable horizon where higher hydraulic loading rates are possible (Hoover et al., 1991; Weymann et al., 1998). A shallow infiltration system covered with fill or an at-grade system can be used if the natural soil has a shallow permeable soil horizon (Converse et al., 1990; Penninger, and Hoover, 1998). If more permeable horizons do not exist, a mound system constructed of suitable sand fill (figure 4-4) can provide more permeable material in which to place the infiltration surface.

4.4.3 Depth of the infiltration surface

The depth of the infiltration surface is an important consideration in maintaining adequate subsoil aeration and frost protection in cold climates. The maximum depth should be limited to no more than 3 to 4 feet below final grade to adequately reaerate the soil and satisfy the daily oxygen demand of the applied wastewater. The infiltrative surface depth should be less in slowly permeable soils or soils with higher ambient moisture. Placement below this depth to take advantage of more permeable soils should be resisted because reaeration of the soil below the infiltration surface will be limited. In cold climates, a minimum depth of 1 to 2 feet may be necessary to protect against freezing. Porous fill material can be used to provide the necessary cover even with an elevated (at-grade or mound) system if it is necessary to place the infiltration surface higher.

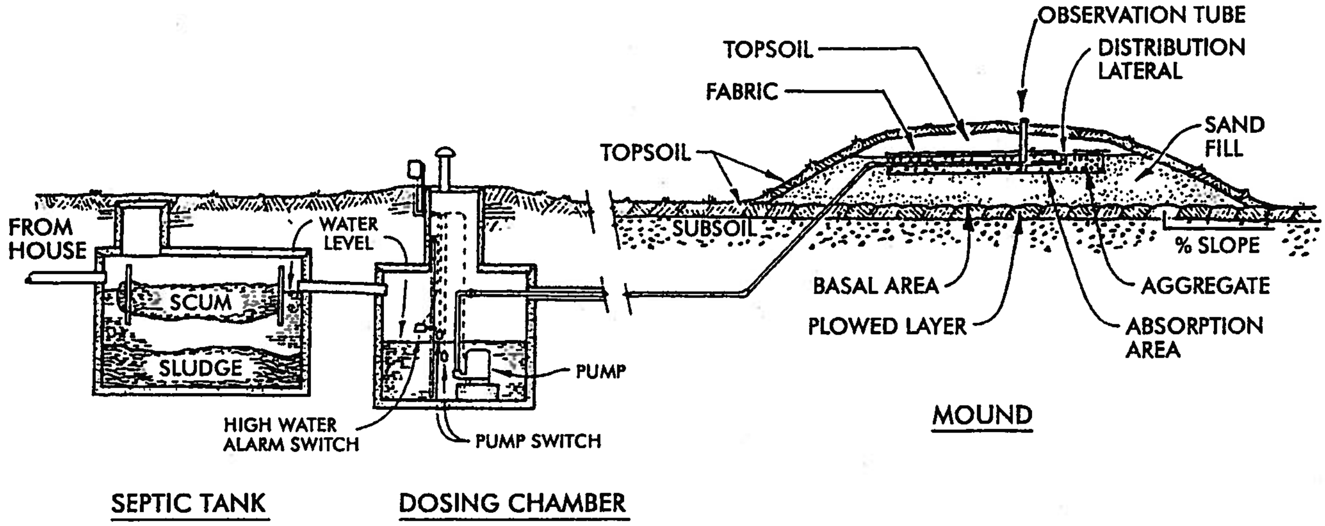
4.4.4 Subsurface drainage

Soils with shallow saturated zones sometimes can be drained to allow the infiltration surface to be placed in the natural soil. Curtain drains, vertical drains, underdrains, and mechanically assisted commercial systems can be used to drain shallow water tables or perched saturated zones. Of the three, curtain drains are most often used in onsite wastewater systems to any great extent. They can be used effectively to remove water that is perched over a slowly permeable horizon on a sloping site. However, poorly drained soils often indicate other soil and site limitations that improved drainage alone will not overcome, so the use of drainage enhancements must be carefully considered. Any sloping site that is subject to frequent inundation during prolonged rainfall should be considered a candidate for upslope curtain drains to maintain unsaturated conditions in the vadose zone.

Curtain drains are installed upslope of the SWIS to intercept the permanent and perched ground water flowing through the site over a restrictive horizon. Perforated pipe is laid in the bottom of upslope trenches excavated into the restrictive horizon. A durable, porous medium is placed around the piping and up to a level above the estimated seasonally high saturated zone. The porous medium intercepts the ground water and conveys it to the drainage pipe (figure 4-5). To provide an outfall for the drain, one or both ends of the pipe are extended downslope to a point where it intercepts the ground surface. When drainage enhancements are used, the outlet and boundary conditions must be carefully evaluated to protect local water quality.

The drain should avoid capture of the SWIS percolate plume and ground water infiltrating from below the SWIS or near the end of the drain. A separation distance between the SWIS and the drain that is sufficient to prevent percolate from the

Figure 4-4. Raising the infiltration surface with a typical mound system.



Source: ASAE, Converse and Tyler, 1998b.

SWIS from entering the drain should be maintained. The vertical distance between the bottom of the SWIS and the drain and soil permeability characteristics should determine this distance. As the vertical distance increases and the permeability decreases, the necessary separation distance increases. A 10-foot separation is used for most applications. Also, if both ends of the drain cannot be extended to the ground surface, the upslope end should be extended some distance along the surface contour beyond the end of the SWIS. If not done, ground water that seeps around the end of the drain can render the drain ineffective. Similar cautions should be observed when designing and locating outlet locations for commercial systems on flat sites.

The design of a curtain drain is based on the permeability of the soil in the saturated zone, the size of the area upslope of the SWIS that contributes water to the saturated zone, the gradient of the drainage pipe, and a suitable outlet configuration.

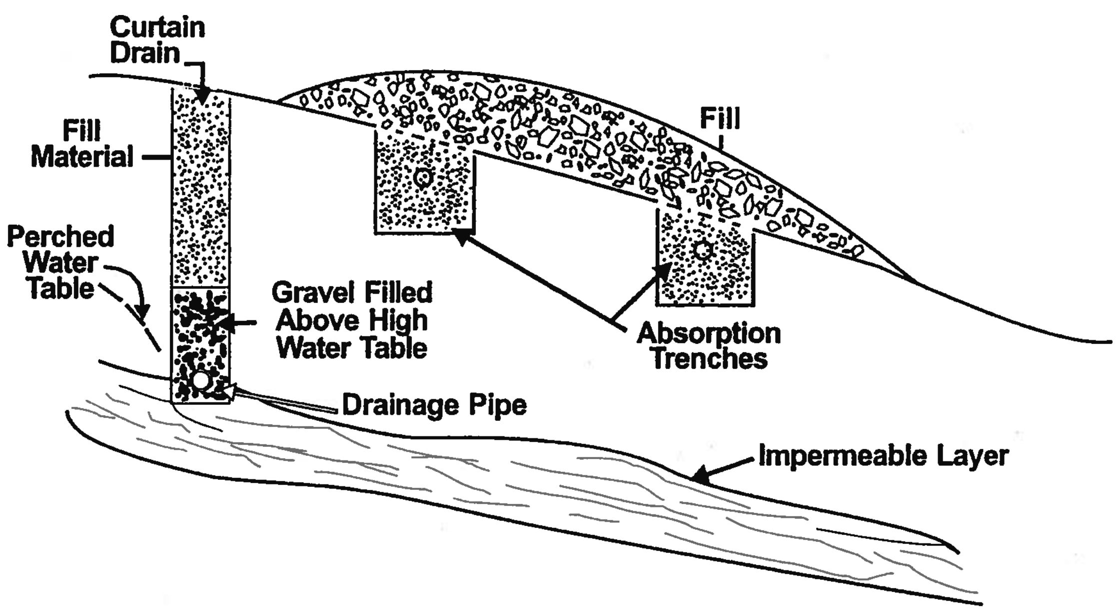


Figure 4-5. Schematic of curtain drain construction
Source: USEPA, 1980

If the saturated hydraulic conductivity is low and the drainable porosity (the percentage of pore space drained when the soil is at field capacity) is small, even effectively designed curtain drains might have limited effect on soil wetness conditions. Penninger et al. (1998) illustrated this at a site with a silty clay loam soil at field capacity that became completely re-saturated with as little as 1-inch of precipitation. Figure 4-6 provides a useful design chart that considers most of these parameters. For further design guidance, refer to the U.S. Department of Agriculture's *Drainage of Agricultural Land* (USDA, 1973).

4.4.5 Sizing of the infiltration surface

The minimum acceptable infiltration surface area is a function of the maximum anticipated daily wastewater volume to be applied and the maximum instantaneous and daily mass loading limitations of the infiltration surface (see chapter 5). Both the bottom and sidewall area of the SWIS excavation can be infiltration surfaces; however, if the sidewall is to be an active infiltration surface, the bottom surface must pond. If continuous ponding of the infiltration surface persists, the infiltration zone will become anaerobic, resulting in loss of hydraulic capacity. Loss of the bottom surface for infiltration will cause the ponding depth to increase over time as the sidewall also clogs (Bouma, 1975; Keys et al., 1998; Otis, 1977). If allowed to continue, hydraulic failure of the system is probable. Therefore, including sidewall area as an active infiltration surface in design should be avoided. If sidewall areas are included, provisions should be made in the design to enable removal of the ponded system from service periodically to allow the system to drain and the biomat to oxidize naturally.

Design flow

An accurate estimation of the design flow is critical to infiltration surface sizing. For existing buildings where significant changes in use are not expected, water service metering will provide good estimates for design. It is best to obtain several weeks of metered daily flows to estimate daily average and peak flows. For new construction, water use metering is not possible and thus waste flow projections must be made based on similar establishments. Tables of "typical" water use or wastewater flows for different water use fixtures, usage patterns, and building uses are available (see section 3.3.1). Incorporated into these guidelines are varying factors of safety. As a result, the use of these guides typically provides conservatively high estimates of maximum peak flows that may occur only occasionally. It is critical that the designer recognizes the conservativeness of these guides and how they can be appropriately adjusted because of their impacts on the design and, ultimately, performance of the system.

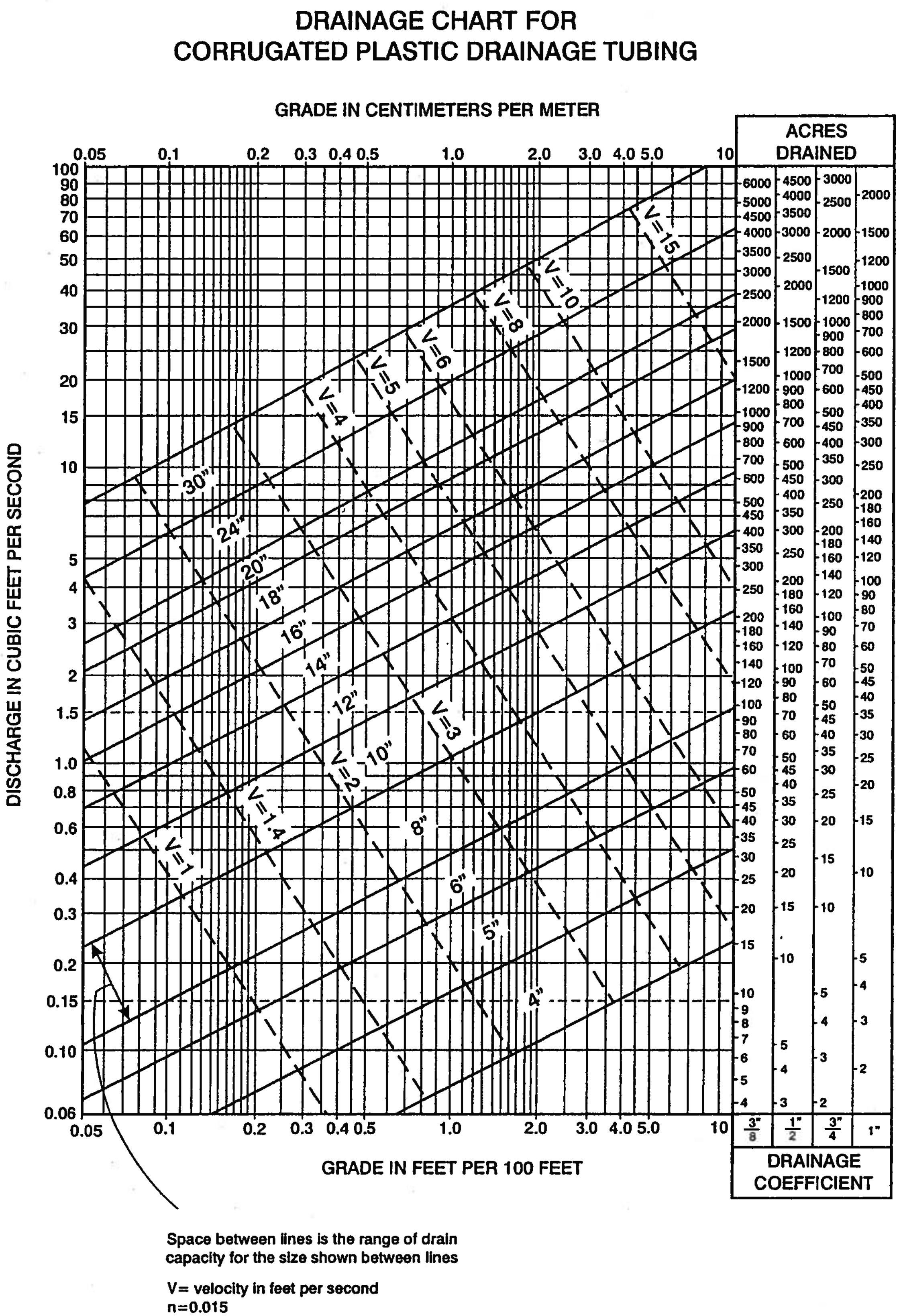
Curtain drain design

Curtain drain design (see preceding figures) is dependent on the size of the contributing drainage area, the amount of water that must be removed, the soil's hydraulic properties, and the available slope of the site.

The contributing drainage area is estimated by outlining the capture zone on a topographic map of the site. Drainage boundaries are determined by extending flow lines perpendicular to the topographic contours upslope from the drain to natural divides (e.g., ridge tops) or natural or man-made "no-flow" boundaries (e.g., rock outcrops, major roads). The amount of water that must be removed is an estimate of the volume of precipitation that would be absorbed by the soil after a rainfall event. This is called the *drainage coefficient*, which is expressed as the depth of water to be removed over a specified period of time, typically 24 hours. Soil structure, texture, bulk density, slope, and vegetated cover all affect the volume of water to be drained.

The slope of the drain can be determined after the upslope depth of the drain invert and the outfall invert are established. These can be estimated from the topographic map of the site. The contributing drainage area, water volume to be removed, and slope of the drain are estimated. Figure 4-6 can be used to determine the drain diameter. For example, the diameter of a curtain drain that will drain an area upslope of 50 acres with a drainage coefficient of ¾ inch on a slope of 5 percent would be 8 inches (see figure). At 0.5 percent, the necessary drain diameter would be 12 inches.

Figure 4-6. Capacity chart for subsurface drains



Source: USDA, 1973.

Infiltration surface loading limitations

Infiltration surface hydraulic loading design rates are a function of soil morphology, wastewater strength, and SWIS design configuration. Hydraulic loadings are traditionally used to size infiltration surfaces for domestic septic tank effluent. In the past, soil percolation tests determined acceptable hydraulic loading rates. Codes provided tables that correlated percolation test results to the necessary infiltration surface areas for different classes of soils. Most states have supplemented this approach with soil morphologic descriptions. Morphologic features of the soil, particularly structure, texture, and consistence, are better predictors of the soil's hydraulic capacity than percolation tests (Brown et al., 1994; Gross et al., 1998; Kleiss and Hoover, 1986; Simon and Reneau, 1987; Tyler et al., 1991; Tyler and Converse, 1994). Although soil texture analysis supplemented the percolation test in most states by the mid-1990s, soil structure has only recently been included in infiltrative surface sizing tables (table 4-3). Consistence, a measure of how well soils form shapes and stick to other objects, is an important consideration for many slowly permeable soil horizons. Expansive clay soils that become extremely firm when moist and very sticky or plastic when wet (exhibiting firm or extremely firm consistence) are not well suited for SWISs.

Not all soil conditions are represented in table 4-3, which is a generic guide to the effects of soil properties on the performance of SWISs. Also

Table 4-3. Suggested hydraulic and organic loading rates for sizing infiltration surfaces

Texture	Structure		Hydraulic loading (gal/ft^2-day)		Organic loading (lb BOD/1000ft^2-day)	
	Shape	Grade	BOD=150	BOD=30	BOD=150	BOD=30
Coarse sand, sand, loamy coarse sand, loamy sand	Single grain	Structureless	0.8	1.6	1.00	0.40
Fine sand, very fine sand, loamy fine sand, loamy very fine sand	Single grain	Structureless	0.4	1.0	0.50	0.25
Coarse sandy loam, sandy loam	Massive	Structureless	0.2	0.6	0.25	0.15
	Platy	Weak	0.2	0.5	0.25	0.13
		Moderate, strong				
	Prismatic, blocky, granular	Weak	0.4	0.7	0.50	0.18
		Moderate, strong	0.6	1.0	0.75	0.25
Fine sandy loam, very fine sandy loam	Massive	Structureless	0.2	0.5	0.25	0.13
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.2	0.6	0.25	0.15
		Moderate, strong	0.4	0.8	0.50	0.20
Loam	Massive	Structureless	0.2	0.5	0.25	0.13
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.4	0.6	0.50	0.15
		Moderate, strong	0.6	0.8	0.75	0.20
Silt loam	Massive	Structureless		0.2	0.00	0.05
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.4	0.6	0.50	0.15
		Moderate, strong	0.6	0.8	0.75	0.20
Sandy clay loam, clay loam, silty clay loam	Massive	Structureless				
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.2	0.3	0.25	0.08
		Moderate, strong	0.4	0.6	0.50	0.15
Sandy clay, clay, silty clay	Massive	Structureless				
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak				
		Moderate, strong	0.2	0.3	0.25	0.08

Source: Adapted from Tyler, 2000.

available are many other state and local guides that include loadings for soils specific to local geomorphology. North Carolina, for example, uses the *long-term acceptance rate* (LTAR) for soil loadings, which is the volume of wastewater that can be applied to a square foot of soil each day over an indefinite period of time such that the effluent from the onsite system is absorbed and properly treated (North Carolina DEHNR, 1996). In the North Carolina rules, LTAR and loading rate values are the same.

Increasingly, organic loading is being used to size infiltration surfaces. Based on current understanding of the mechanisms of SWIS operation, organic loadings and the reaeration potential of the subsoil to meet the applied oxygen demand are critical considerations in successful SWIS design. Anaerobic conditions are created when the applied oxygen demand exceeds what the soil is able to supply by diffusion through the vadose zone (Otis, 1985, 1997; Siegrist et al., 1986). The facultative and anaerobic microorganisms that are able to thrive in this environment are less efficient in degrading the waste materials. The accumulating waste materials and the metabolic by-products cause soil clogging and loss of infiltrative capacity.

Further, higher forms of soil fauna that would help break up the biomat (e.g., worms, insects, non-wetland plants) and would be attracted to the carbon and nutrient-rich infiltration zone are repelled by the anoxic or anaerobic environment. If wastewater application continues without ample time to satisfy the oxygen demand, hydraulic failure due to soil clogging occurs. Numerous studies have shown that wastewaters with low BOD concentrations (e.g., < 50 mg/L) can be applied to soils at rates 2 to 16 times the typical hydraulic loading rate for domestic septic tank effluent (Jones and Taylor, 1965; Laak, 1970, 1986; Louden et al., 1998; Otis, 1985; Siegrist and Boyle, 1987; Tyler and Converse, 1994).

The comparatively higher hydraulic loadings that highly treated wastewater (highly treated in terms of TSS, ammonium-nitrogen, and BOD) may permit should be considered carefully because the resulting rapid flow through the soil may allow deep penetration of pathogens (Converse and Tyler, 1998a, 1998b; Siegrist et al., 2000; Siegrist and Van Cuyk, 2001b; Tyler and Converse, 1994). The trench length perpendicular to ground water movement (footprint) should remain the same to minimize system impacts on the aquifer.

Unfortunately, well-tested organic loading rates for various classes of soils and SWIS design configurations have not been developed. Most organic loading rates have been derived directly from the hydraulic loadings typically used in SWIS design by assuming a BOD_5 concentration (see box and table 4-3). The derived organic loading rates also incorporate the implicit factor of safety found in the hydraulic loading rates. Organic loadings do appear to have less impact on slowly permeable soils because the resistance of the biomat that forms at the infiltrative surface presents less resistance to infiltration of the wastewater than the soil itself (Bouma, 1975). For a further discussion of SWIS performance under various environmental conditions, see Siegrist and Van Cuyk, 2001b.

Constituent mass loadings

Constituent mass loadings may be a concern with respect to water quality. For example, to use the soil's capacity to adsorb and retain phosphorus when systems are located near sensitive surface waters, a phosphorus loading rate based on the soil adsorption capacity might be selected as the controlling rate of wastewater application to the infiltration surface to maximize phosphorus removal. Placement of the effluent distribution piping high in the soil profile can promote greater phosphorus removal because the permeability of medium- and fine-textured soils tends to decrease with depth and because the translocation of aluminum and iron—which react with phosphorus to form insoluble compounds retained in the soil matrix—occurs in some sandy soils, with the maximum accumulation usually above 45 cm (Mokma et al., 2001). Many lakes are surrounded by sandy soils with a low phosphorus adsorption capacity. If effluent distribution systems are installed below 45 cm in these sandy soils, less phosphorus will be removed from the percolating effluent. In the case of a soluble constituent of concern such as nitrate-nitrogen, a designer might decide to reduce the mass of nitrate per unit of application area. This would have the effect of increasing the size of the SWIS footprint, thereby reducing the potential concentration of nitrate in the ground water immediately surrounding the SWIS (Otis, 2001).

Factors of safety in infiltration surface sizing

Sizing of onsite wastewater systems for single-family homes is typically based on the estimated peak daily flow and the "long term acceptance rate" of the soil for septic tank effluent. In most states, the design flow is based on the number of bedrooms in the house. A daily flow of 150 gallons is commonly assumed for each bedroom. This daily flow per bedroom assumes two people per bedroom that generate 75 gpd each. Bedrooms, rather than current occupancy, are used for the basis of SWIS design because the number of occupants in the house can change.

Using this typical estimating procedure, a three-bedroom home would have a design flow of 150 gpd/bedroom x 3 bedrooms or 450 gpd. However, the actual daily average flow could be much less. Based on the 1990 census, the average home is occupied by 2.8 persons. Each person in the United States generates 45 to 70 gpd of domestic wastewater. Assuming these averages, the average daily flow would be 125 to 195 gpd or 28 to 44 percent of the design flow, respectively. Therefore, the design flow includes an implicit factor of safety of 2.3 to 3.6. Of course, this factor of safety varies inversely with the home occupancy and water use.

Unfortunately, the factors of safety implicitly built into the flow estimates are seldom recognized. This is particularly true in the case of the design hydraulic loading rates, which were derived from existing SWISs. In most codes, the hydraulic loading rates for sand are about 1.0 to 1.25 gpd/ft^2. Because these hydraulic loading rates assume daily flows of 150 gpd per bedroom, they are overestimated by a factor of 2.3 to 3.6. Fortunately, these two assumptions largely cancel each other out in residential applications, but the suggested hydraulic loading rates often are used to size commercial systems and systems for schools and similar facilities, where the ratios between design flows and actual daily flows are closer to 1.0. This situation, combined with a lack of useful information on allowable organic loading rates, has resulted in failures, particularly for larger systems where actual flow approximates design.

4.4.6 Geometry, orientation, and configuration of the infiltration surface

The geometry, orientation, and configuration of the infiltration surface are critical design factors that affect the performance of SWISs. They are important for promoting subsoil aeration, maintaining an acceptable separation distance from a saturated zone or restrictive horizon, and facilitating construction. Table 4-4 lists the design considerations discussed in this section.

Geometry

The width and length of the infiltration surface are important design considerations to improve performance and limit impacts on the receiving environment. Trenches, beds, and seepage pits (or dry wells) are traditionally used geometries. Seepage pits can be effective for wastewater dispersal, but they provide little treatment because they extend deep into the soil profile, where oxygen transfer and treatment are limited and the separation distance to ground water is reduced. They are not recommended for onsite wastewater treatment and are not included as an option in this manual.

Width

Infiltration surface clogging and the resulting loss of infiltrative capacity are less where the infiltration surface is narrow. This appears to occur because reaeration of the soil below a narrow infiltration surface is more rapid. The dominant pathway for oxygen transport to the subsoil appears to be diffusion through the soil surrounding the infiltration surface (figure 4-7). The unsaturated zone below a wide surface quickly becomes anaerobic because the rates of oxygen diffusion are too low to meet the oxygen demands of biota and organics on the infiltration surface. (Otis, 1985; Siegrist et al., 1986). Therefore, trenches perform better than beds. Typical trench widths range from 1 to 4 feet. Narrower trenches are preferred, but soil conditions and construction techniques might limit how narrow a trench can be constructed. On sloping sites, narrow trenches are a necessity because in keeping the infiltration surface level, the uphill side of the trench bottom might be excavated into a less suitable soil horizon. Wider trench infiltration surfaces have been successful in at-grade systems and mounds probably because the engineered fill material and elevation above the natural grade promote better reaeration of the fill.

Comparing hydraulic and organic mass loadings for a restaurant wastewater

Infiltration surface sizing traditionally has been based on the daily hydraulic load determined through experience to be acceptable for the soil characteristics. This approach to sizing fails to account for changes in applied wastewater strength. Since soil clogging has been shown to be dependent on applied wastewater strength, it might be more appropriate to size infiltration surfaces based on organic mass loadings.

To illustrate the impact of the different sizing methods, sizing computations for a restaurant are compared. A septic tank is used for pretreatment prior to application to the SWIS. The SWIS is to be constructed in a sandy loam with a moderate, subangular blocky structure. The suggested hydraulic loading rate for domestic septic tank effluent on this soil is 0.6 gpd/ft² (table 4-3). The restaurant septic tank effluent has the following characteristics:

BOD_5	800 mg/L
TSS	200 mg/L
Average daily flow	600 gpd

Infiltration area based on hydraulic loading:

Area = 600 gpd/0.6 gpd/ft² = 1,000 ft²

Infiltration area based on organic loading:

At the design infiltration rate of 0.6 gpd/ft² recommended for domestic septic tank effluent, the equivalent organic loading is (assuming a septic tank BOD_5 effluent concentration of 150 mg/L)

$$\text{Organic Loading} = 150\ \text{mg/L} \times 0.6\ \text{gpd/ft}^2 \times (8.34\ \text{lb/mg/L} \times 10^{-6}\ \text{gal})$$
$$= 7.5 \times 10^{-4}\ \text{lb BOD}_5/\text{ft}^2\text{-d}$$

Assuming 7.5×10^{-4} lb BOD_5/ft²-d as the design organic loading rate,

$$\text{Area} = \frac{(800\ \text{mg-BOD}_5/\text{L} \times 600\ \text{gpd} \times 8.34\ \text{lbs/mg/L} \times 10^{-6}\ \text{gal})}{(7.5 \times 10^{-4}\ \text{lb BOD}_5/\text{ft}^2\text{-d})}$$

$$= \frac{4.0\ \text{lb BOD}_5/\text{d}}{(7.5 \times 10^{-4}\ \text{lb BOD}_5/\text{ft}^2\text{-d})} = 5337\ \text{ft}^2\ \text{(a 540\% increase)}$$

Impact of a 40% water use reduction on infiltration area sizing

Based on hydraulic loading,

$$\text{Area} = \frac{(1 - 0.4) \times 600\ \text{gpd}}{0.6\ \text{gpd/ft}^2} = 600\ \text{ft}^2$$

Based on organic loading (note the concentration of BOD_5 increases with water conservation but the mass of BOD_5 discharged does not change),

$$\text{Area} = \frac{(800\ \text{mg-BOD}_5/\text{L} \times 600\ \text{gpd}) \times (8.34\ \text{lb/mg/L} \times 10^{-6}\ \text{gal})}{[(1 - 0.4) \times 600\ \text{gpd}] \times (7.5 \times 10^{-4}\ \text{lb BOD}_5/\text{ft}^2\text{-d})}$$

$$= \frac{4.0\ \text{lb BOD}_5/\text{d}}{(7.5 \times 10^{-4}\ \text{lb BOD}_5/\text{ft}^2\text{-d})} = 5337\ \text{ft}^2\ \text{(an 890\% increase)}$$

However, infiltration bed surface widths of greater than 10 feet are not recommended because oxygen transfer and clogging problems can occur (Converse and Tyler, 2000; Converse et al., 1990).

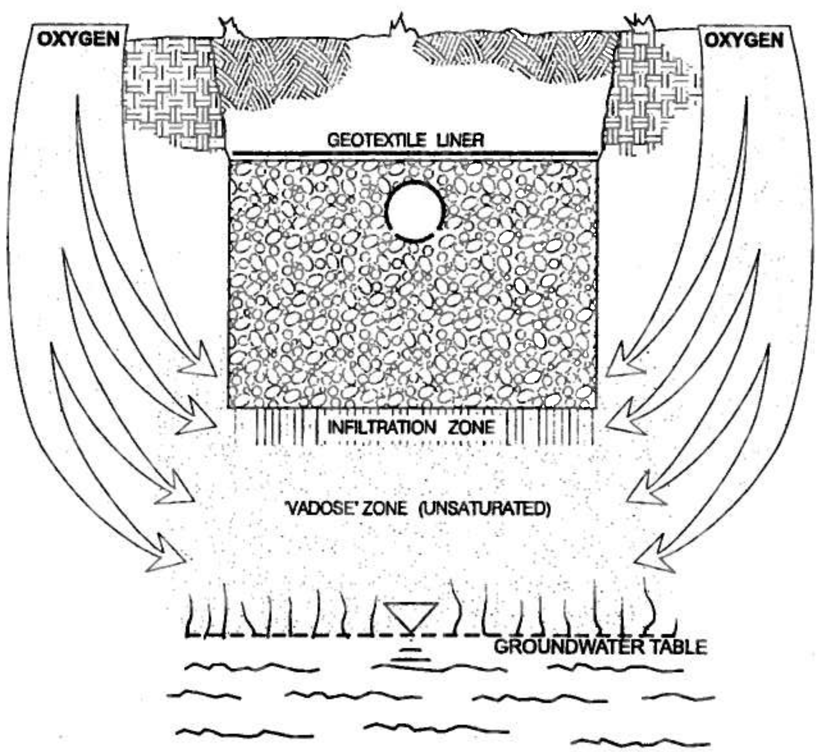
Length

The trench length is important where downslope linear loadings are critical, ground water quality impacts are a concern, or the potential for ground water mounding exists. In many jurisdictions, trench lengths have been limited to 100 feet. This restriction appeared in early codes written for gravity distribution systems and exists as an artifact with little or no practical basis when pressure distribution is used. Trench lengths longer than 100 feet might be necessary to minimize ground water impacts and to permit proper wastewater drainage from the site. Long trenches can be used to reduce the linear loadings on a site by spreading the

Table 4-4. Geometry, orientation, and configuration considerations for SWISs

Design type	Design considerations
Trench	
Geometry	
Width	Preferably less than 3 ft. Design width is affected by distribution method, constructability, and available area.
Length	Restricted by available length parallel to site contour, distribution method, and distribution network design.
Sidewall height	Sidewalls are not considered an active infiltration surface. Minimum height is that needed to encase the distribution piping or to meet peak flow storage requirements.
Orientation/ configuration	Should be constructed parallel to site contours and/or water table or restrictive layer contours. Should not exceed the site's maximum linear hydraulic loading rate per unit of length. Spacing of multiple, parallel trenches is also limited by the construction method and slow dispersion from the trenches.
Bed	
Geometry	
Width	Should be as narrow as possible. Beds wider than 10 to 15 feet should be avoided.
Length	Restricted by available length parallel to site contour, distribution method, and distribution network design.
Sidewall height	Sidewalls are not considered an active infiltration surface. Minimum height is that needed to encase the distribution piping or to meet peak flow storage requirements.
Orientation/ configuration	Should be constructed parallel to site contours and/or water table or restrictive layer contours. The loading over the total projected width should not exceed the estimated downslope maximum linear hydraulic loading.
Seepage pit	Not recommended because of limited treatment capability.

Figure 4-7. Pathway of subsoil reaeration



Source: Ayres Associates, 2000

wastewater loading parallel to and farther along the surface contour. With current distribution/dosing technology, materials, and construction methods, trench lengths need be limited only by what is practical or feasible on a given site. Also, use of standard trench lengths, e.g., X feet of trench/BR, is discouraged because it restricts the design options to optimize performance for a given site condition.

Height

The height of the sidewall is determined primarily by the type of porous medium used in the system, the depth of the medium needed to encase the distribution piping, and/or storage requirements for peak flows. Because the sidewall is not included as an active infiltration surface in sizing the infiltration area, the height of the sidewall can be minimized to keep the infiltration surface high in the soil profile. A height of 6 inches is usually sufficient for most porous aggregate applications. Use of a gravelless system requires a separate analysis to determine the height based on whether it is an aggregate-free (empty chamber) design or one that substitutes a lightweight aggregate for washed gravel or crushed stone.

Orientation

Orientation of the infiltration surface(s) becomes an important consideration on sloping sites, sites with shallow soils over a restrictive horizon or saturated zone, and small or irregularly shaped lots. The long axes of trenches should be aligned parallel to the ground surface contours to reduce linear contour hydraulic loadings and ground water mounding potential. In some cases, ground water or restrictive horizon contours may differ from surface contours because of surface grading or the soil's morphological history. Where this occurs, consideration should be given to aligning the trenches with the contours of the limiting condition rather than those of the surface. Extending the trenches perpendicular to the ground water gradient reduces the mass loadings per unit area by creating a "line" source rather than a "point" source along the contour. However, the designer must recognize that the depth of the trenches and the soil horizon in which the infiltration surface is placed will vary across the system. Any adverse impacts this might have on system performance should be mitigated through design adjustments.

Configuration

The spacing of multiple trenches constructed parallel to one another is determined by the soil characteristics and the method of construction. The sidewall-to-sidewall spacing must be sufficient to enable construction without damage to the adjacent trenches. Only in very tight soils will normally used spacings be inadequate because of high soil wetness and capillary fringe effects, which can limit oxygen transfer. It is important to note that the sum of the hydraulic loadings to one or more trenches or beds per each unit of contour length (when projected downslope) must not exceed the estimated maximum contour loading for the site. Also, the finer (tighter) the soil, the greater the trench spacing should be to provide sufficient oxygen transfer. Quantitative data are lacking, but Camp (1985) reported a lateral impact of more than 2.0 meters in a clay soil.

Given the advantages of lightweight gravelless systems in terms of potentially reduced damage to the site's hydraulic capacity, parallel trenches may physically be placed closer together, but the downslope hydraulic capacity of the site and the natural oxygen diffusion capacity of the soil cannot be exceeded.

4.4.7 Wastewater distribution onto the infiltration surface

The method and pattern of wastewater distribution in a subsurface infiltration system are important design elements. Uniform distribution aids in maintaining unsaturated flow below the infiltration surface, which results in wastewater retention times in the soil that are sufficiently long to effect treatment and promote subsoil reaeration. Uniform distribution design also results in more complete utilization of the infiltration surface.

Gravity flow and dosing are the two most commonly used distribution methods. For each method, various network designs are used (table 4-5). Gravity flow is the most commonly used method because it is simple and inexpensive. This method discharges effluent from the septic tank or other pretreatment tank directly to the infiltration surface as incoming wastewater displaces it from the tank(s). It is characterized by the term "trickle flow" because the effluent is slowly discharged over much of the day. Typically, tank discharges are too low to flow throughout the distribution network. Thus, distribution is unequal and localized overloading of the infiltration surface occurs with concomitant poor treatment and soil clogging (Bouma, 1975; McGauhey and Winneberger, 1964; Otis, 1985; Robeck et al., 1964).

Dosing, on the other hand, accumulates the wastewater effluent in a dose tank from which the water is periodically discharged under pressure in "doses" to the infiltration system by a pump or siphon. The pretreated wastewater is allowed to accumulate in the dose tank and is discharged when a predetermined water level, water volume, or elapsed time is reached. The dose volumes and discharge rates are usually such that much of the distribution network is filled, resulting in more uniform distribution over the infiltration surface. Dosing outperforms gravity-flow systems because distribution is more uniform. In addition, the periods between doses provide opportunities for the subsoil to drain and reaerate before the next dose (Bouma et al., 1974; Hargett et al., 1982; Otis et al., 1977). However, which method is most appropriate depends on the specific application.

Gravity flow

Gravity flow can be used where there is a sufficient elevation difference between the outlet of the pretreatment tank and the SWIS to allow flow to and through the SWIS by gravity. Gravity flow systems are simple and inexpensive to construct but are the least efficient method of distribution. Distribution is very uneven over the infiltration surface, resulting in localized overloading (Converse, 1974; McGauhey and Winneberger, 1964; Otis et al., 1978; University of Wisconsin, 1978). Until a biomat forms on the infiltration surface to slow the rate of infiltration, the wastewater residence time in the soil might be too short to effect good treatment. As the biomat continues to form on the overloaded areas, the soil surface becomes clogged, forcing wastewater effluent to flow through the porous medium of the trench until it reaches an unclogged infiltration surface. This phenomenon, known as "progressive clogging," occurs until the entire infiltration surface is ponded and the sidewalls become the more active infiltration surfaces. Without extended periods of little or no flow to allow the surface to dry, hydraulic failure becomes imminent. Although inefficient, these systems can work well for seasonal homes with intermittent use or for households with low occupancies. Seasonal use of SWISs allows the infiltration surface to dry and the biomat to oxidize, which rejuvenates the infiltration capacity. Low occupancies result in mass loadings of wastewater constituents that are lower and less likely to exceed the soil's capacity to completely treat the effluent.

Perforated pipe

Four-inch-diameter perforated plastic pipe is the most commonly used distribution piping for

Table 4-5. Distribution methods and applications.

Method	Typical applications
Gravity flow	
4-inch perforated pipe	Single or looped trenches at the same elevation; beds.
Distribution box	Multiple independent trenches on flat or sloping sites.
Serial relief line	Multiple serially connected trenches on a sloping site.
Drop box	Multiple independent trenches on a sloping site.
Dosed distribution	
4-inch perforated pipe (with or without a distribution box)	Single (or multiple) trenches, looped trenches at the same elevation, an d beds.
Pressure manifold	Multiple independent trenches on sloping sites.
Rigid pipe pressure network	Multiple independent trenches at the same elevation (a preferred method for larger SWISs)
Dripline pressure network	Multiple independent trenches on flat or sloping sites (a preferred method for larger SWISs)

gravity flow systems. The piping is generally smooth-walled rigid polyvinyl chloride (PVC), or flexible corrugated polyethylene (PE) or acrylonitrile-butadiene-styrene (ABS). One or two rows of holes or slots spaced 12 inches apart are cut into the pipe wall. Typically, the piping is laid level in gravel (figure 4-1) with the holes or slots at the bottom (ASTM, undated). One distribution line is used per trench. In bed systems, multiple lines are installed 3 to 6 feet apart.

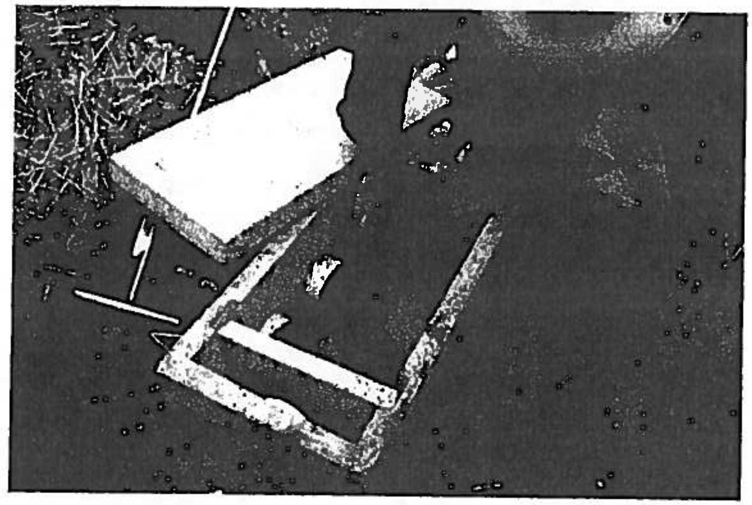
Distribution box

Distribution boxes are used to divide the wastewater effluent flow among multiple distribution lines. They are shallow, flat bottomed, watertight structures with a single inlet and individual outlets provided at the same elevation for each distribution line. An above-grade cover allows access to the inside of the box. The "d-box" must be laid level on a sound, frost-proof footing to divide the flow evenly among the outlets. Uneven settlement or frost heaving results in unequal flow to the lateral lines because the outlet hole elevations cease to be level. If this occurs, adjustments must be made to reestablish equal division of flow. Several devices can be used. Adjustable weirs that can level the outlet inverts and maintain the same length of weir per outlet are one option. Other options include designs that allow for leveling of the entire box (figure 4-8). The box can also be used to take individual trenches out of service by blocking the outlet to the distribution lateral or raising the outlet weir above the weir elevations for the other outlets. Because of the inevitable movement of d-boxes, their use has been discouraged for many years (USPHS, 1957). However, under a managed care system with regular adjustment, the d-box is acceptable.

Serial relief line

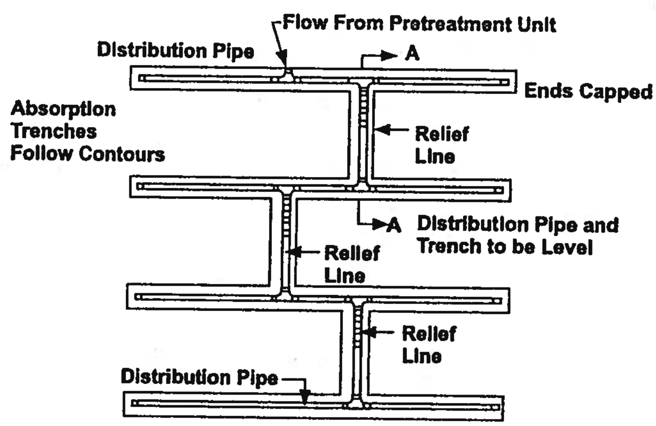
Serial relief lines distribute wastewater to a series of trenches constructed on a sloping site. Rather than dividing the flow equally among all trenches as with a distribution box, the uppermost trench is loaded until completely flooded before the next (lower) trench receives effluent. Similarly, that trench is loaded until flooded before discharge occurs to the next trench, and so on. This method of loading is accomplished by installing "relief lines" between successive trenches (figure 4-9).

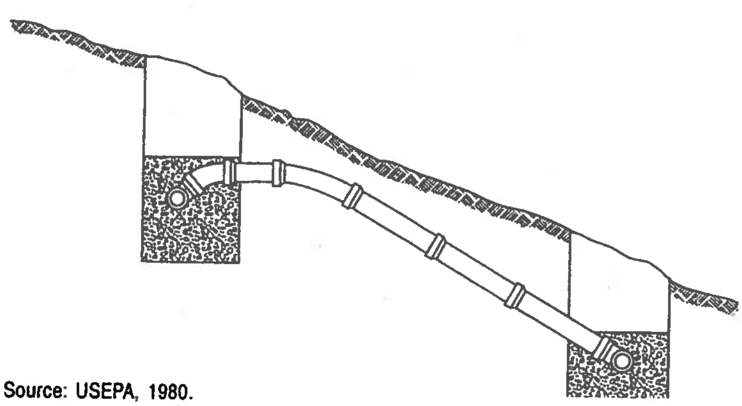
Figure 4-8. Distribution box with adjustable weir outlets



Source: Ayres Associates.

Figure 4-9. Serial relief line distribution network and installation detail





Source: USEPA, 1980.

The relief lines are simple overflow lines that connect one trench to the adjacent lower trench. They are solid-wall pipes that connect the crown of the upper trench distribution pipe with the distribution pipe in the lower trench. Successive relief lines are separated by 5 to 10 feet to avoid short-circuiting. This method of distribution makes full hydraulic use of all bottom and sidewall infiltration surfaces, creates the maximum hydrostatic head over the infiltration surfaces to force the water into the surrounding soil, and eliminates the problem of dividing flows evenly among independent trenches. However, because continuous ponding of the infiltration surfaces is necessary for the system to function, the trenches suffer hydraulic failure more rapidly and progressively because the infiltration surfaces cannot regenerate their infiltrative capacity.

Drop box

Drop box distribution systems function similarly to relief line systems except that drop boxes are used in place of the relief lines. Drop boxes are installed for each trench. They are connected in manifolds to trenches above and below (figure 4-10). The outlet invert can be placed near the top of each trench to force the trench to fill completely before it discharges to the next trench if a serial distribution mode of operation is desired. Solid-wall pipe is used between the boxes.

The advantage of this method over serial relief lines is that individual trenches can be taken out of service by attaching 90 degree ells to the outlets that rise above the invert of the manifold connection to the next trench drop box. It is easier to add additional trenches to a drop box system than to a serial relief line network. Also, the drop box system may be operated as an alternating trench system by using the 90 degree ells on unused lines. With this and the serial distribution system, the designer must carefully evaluate the downslope capacity of the site to ensure that it will not be overloaded when the entire system or specific trench combinations are functioning.

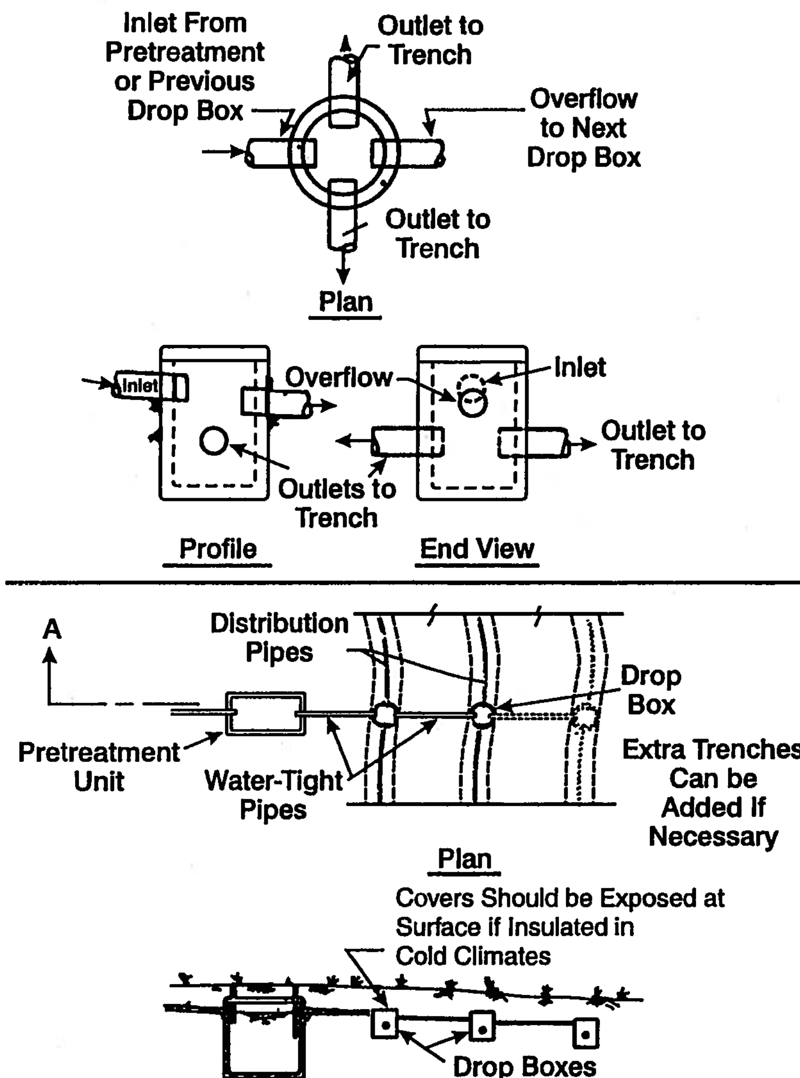
Gravelless wastewater dispersal systems

Gravelless systems have been widely used. They take many forms, including open-bottomed chambers, fabric-wrapped pipe, and synthetic materials such as expanded polystyrene foam chips (figure 4-11). Some gravelless drain field systems use large-diameter corrugated plastic tubing covered with permeable nylon filter fabric not surrounded by gravel or rock. The area of fabric in contact with the soil provides the surface for the septic tank effluent to infiltrate the soil. The pipe is a minimum of 10 to 12 inches (25.4 to 30.5 centimeters) in diameter covered with spun bonded nylon filter fabric to distribute water around the pipe. The pipe is placed in a 12- to 24-inch (30.5- to 61-centimeter)-wide trench. These systems can be installed in areas with steep slopes with small equipment and in hand-dug trenches where conventional gravel systems would not be possible.

Reduced sizing of the infiltration surface is often promoted as another advantage of the gravelless system. This is based primarily on the premise that gravelless systems do not "mask" the infiltration surface as gravel does where the gravel is in direct contact with the soil. Proponents of this theory claim that an infiltration surface area reduction of 50 percent is warranted. However, these reductions are not based on scientific evidence though they have been codified in some jurisdictions (Amerson et al., 1991; Anderson et al., 1985; Carlile and Osborne, 1982; Effert and Cashell, 1987). Although gravel masking might occur in porous medium applications, reducing the infiltration surface area for gravelless systems increases the BOD mass loading to the available infiltration surface. Many soils might not be able to support the higher organic loading and, as a result, more severe soil clogging and greater penetration of pollutants into the vadose zone and ground water can occur (University of Wisconsin, 1978), negating the benefits of the gravelless surface.

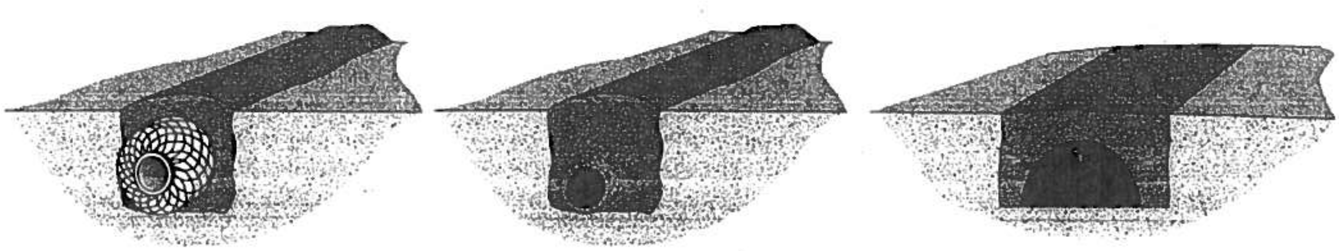
A similar approach must be taken with any contaminant in the pretreatment system effluent that must be removed before it reaches ground water or nearby surface waters. A 50 percent reduction in infiltrative surface area will likely result in less removal of BOD, pathogens, and other contaminants in the vadose zone and increase the presence and concentrations of contaminants in effluent plumes. The relatively confined travel path of a plume provides fewer adsorption sites for removal of adsorbable contaminants (e.g., metals, phosphorus, toxic organics). Because any potential reductions in infiltrative surface area must be analyzed in a similar comprehensive fashion, the use of

Figure 4-10. Drop box distribution network



Source: USEPA, 1980

Figure 4-11. Various gravelless systems



Source: National Small Flows Clearinghouse.

gravelless medium should be treated similarly to potential reductions from increased pretreatment and better distribution and dosing concepts.

Despite the cautions stated above, the overall inherent value of lightweight gravelless systems should not be ignored, especially in areas where gravel is expensive and at sites that have soils that are susceptible to smearing or other structural damage during construction due to the impacts of heavy machinery on the site. In all applications where gravel is used (see *SWIS Media* in the following section), it must be properly graded and washed. Improperly washed gravel can contribute fines and other material that can plug voids in the infiltrative surface and reduce hydraulic capability. Gravel that is embedded into clay or fine soils during placement can have the same effect.

Leaching chambers

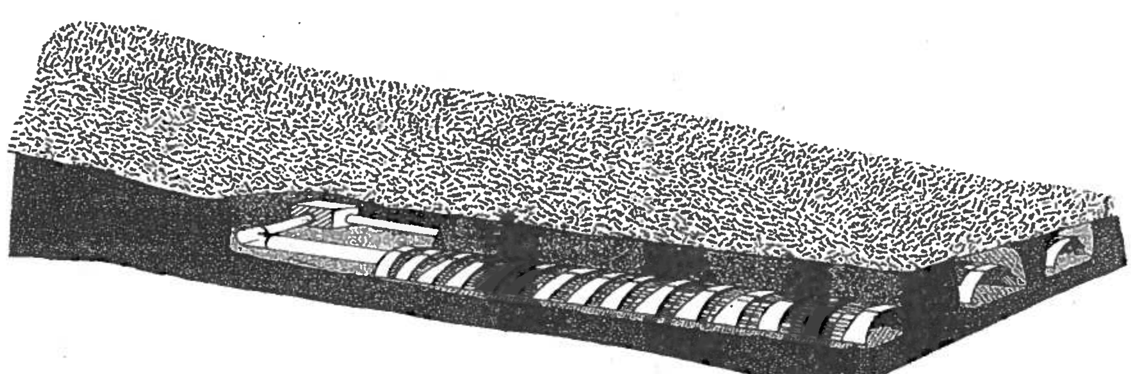
A leaching chamber is a wastewater treatment system that consists of trenches or beds and one or more distribution pipes or open-bottomed plastic chambers. Leaching chambers have two key functions: to disperse the effluent from septic tanks and to distribute this effluent throughout the trenches. A typical leaching chamber consists of several high-density polyethylene injection-molded arch-shaped chamber segments. A typical chamber has an average inside width of 15 to 40 inches (38 to 102 centimeters) and an overall length of 6 to 8 feet (1.8 to 2.4 meters). The chamber segments are usually 1-foot high, with wide slotted sidewalls. Depending on the drain field size requirements, one or more chambers are typically connected to form an underground drain field network.

Typical leaching chambers (figure 4-12) are gravelless systems that have drain field chambers with no bottoms and plastic chamber sidewalls, available in a variety of shapes and sizes. Use of these systems sometimes decreases overall drain field costs and may reduce the number of trees that must be removed from the drain field lot.

About 750,000 chamber systems have been installed over the past 15 years. Currently, a high percentage of new construction applications use lightweight plastic leaching chambers for new wastewater treatment systems in states like Colorado, Idaho, North Carolina, Georgia, Florida, and Oregon. The gravel aggregate traditionally used in drain fields can have large quantities of mineral fines that also clog or block soil pores. Use of leaching chambers avoids this problem. Recent research sponsored by manufacturers shows promising results to support reduction in sizing of drain fields through the use of leaching chambers without increased hydraulic and pollutant penetration failures (Colorado School of Mines, 2001; Siegrist and Vancuyk, 2001a, 2001b). These studies should be continued to eventually yield rational guidelines for proper sizing of these systems based on the type of pretreatment effluent to be received (septic tank effluent, effluent from filters or aerobic treatment units, etc.), as well as different soil types and hydrogeological conditions. Many states offer drain field sizing reduction allowances when leaching chambers are used instead of conventional gravel drain fields.

Because leaching chamber systems can be installed without heavy equipment, they are easy to install

Figure 4-12. Placement of leaching chambers in typical application



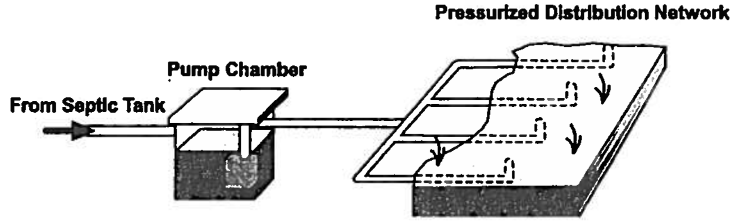
Source: Hoover et al., 1996.

and repair. These high-capacity, open-bottom drain field systems can provide greater storage than conventional gravel systems and can be used in areas appropriate for gravel aggregate drain fields. Leaching systems can operate independently and require little day-to-day maintenance. Their maintenance requirements are comparable to those of aggregate trench systems.

The lightweight chamber segments available on the market stack together compactly for efficient transport. Some chambers interlock with ribs without fasteners, cutting installation time by more than 50 percent reused and conventional gravel/pipe systems. Such systems can be reused and relocated if the site owner decides to build on another drain field site. A key disadvantage of leaching chambers compared to gravel drain fields is that they can be more expensive if a low-cost source of gravel is readily available.

Porous media should be placed along the chamber sidewall area to a minimum compacted height of 8 inches above the trench bottom. Additional backfill is placed to a minimum compacted height of 6 to12 inches above the chamber, depending on the chamber strength. Individual chamber trench bottoms should be leveled in all directions and follow the contour of the ground surface elevation without any dams or other water stops. The manufacturer's installation instructions should be followed, and systems should be installed by an authorized contractor.

Figure 4-13. Typical pressurized distribution system layout



Source: National Small Flows Clearinghouse

Dosed flow distribution

Dosed-flow distribution systems are a significant improvement over gravity-flow distribution systems. The design of dosed-flow systems (figure 4-13) includes both the distribution network and the dosing equipment (see table 4-6). Dosing achieves better distribution of the wastewater effluent over the infiltration surface than gravity flow systems and provides intervals between doses when no wastewater is applied. As a result, dosed-flow systems reduce the rate of soil clogging, more effectively maintain unsaturated conditions in the subsoil (to effect good treatment through extended residence times and increased reaeration potential), and provide a means to manage wastewater effluent applications to the infiltration system (Hargett et al., 1982). They can be used in any application and should be the method of choice. Unfortunately, they are commonly perceived to be less desirable because they add a mechanical

Table 4-6. Dosing methods and devices.

Dosing method	Typical application
On-Demand	Dosing occurs when a sufficient volume of wastewater has accumulated in the dose tank to activate the pump switch or siphon. Dosing continues until the preselected low water level is reached. Typically, there is no control on the daily volume of wastewater dosed.
Timed	Dosing is performed by pumps on a timed cycle, typically at equal intervals and for preset dose volumes so that the daily volume of wastewater dosed does not exceed the system's design flow. Controls can be set so that only full doses occur. Peak flows are stored in the dose tank for dosing during low flow periods. Excessive flows are retained in the tank, and, if they persist, a high water alarm alerts the owner of the need for remedial action. This approach prevents unwanted and detrimental discharges to the SWIS.
Dosing device	
Pump	Pressure distribution networks are set at elevations that are typically higher than the dose tank. Multiple infiltration areas can be dosed from the same tank using multiple, alternating pumps or automatic valves.
Siphon	On-demand dosing of gravity or pressure distribution networks is used where the elevation between the siphon invert and the distribution pipe orifices is sufficient for the siphon to operate. Siphons cannot be used for timed dosing. Two siphons in the same dose tank can be used to alternate automatically between two infiltration areas.

component to an otherwise "passive" system and add cost because of the dosing equipment. The improved performance of dosed-flow systems over gravity flow systems should outweigh these perceived disadvantages, especially when a management entity is in place. It must be noted, however, that if dosed infiltration systems are allowed to pond, the advantages of dosing are lost because the bottom infiltration surface is continuously inundated and no longer allowed to rest and reaerate. Therefore, there is no value in using dosed-flow distribution in SWISs designed to operate ponded, such as systems that include sidewall area as an active infiltration surface or those using serial relief lines.

Perforated pipe

Four-inch perforated pipe networks (with or without d-boxes or pressure manifolds) that receive dosed-flow applications are designed no differently than gravity-flow systems. Many of the advantages of dosing are lost in such networks, however, because the distribution is only slightly better than that of gravity-flow systems (Converse, 1974).

Pressure manifold

A pressure manifold consists of a large-diameter pipe tapped with small outlet pipes that discharge to gravity laterals (figure 4-14). A pump pressurizes the manifold, which has a selected diameter to ensure that pressure inside the manifold is the same at each outlet. This method of flow division is more accurate and consistent than a distribution box, but it has the same shortcoming since flow after the manifold is by gravity along each distribution lateral. Its most common application is to divide flow among multiple trenches constructed at different elevations on a sloping site.

Table 4-7 can be used to size a pressure manifold for different applications (see sidebar). This table was developed by Berkowitz (1985) to size the manifold diameter based on the spacing between pressure lateral taps, the lateral tap diameter, and the number of lateral taps. The hydraulic computations made to develop the table set a maximum flow differential between laterals of 5 percent. The dosing rate is determined by calculating the flow in a single lateral tap assuming 1 to 4 feet of head at the manifold outlets and multiplying the result by the number of lateral taps. The Hazen-Williams equation for pipe flow can be used to make this calculation.

Pressure distribution is typically constructed of Schedule 40 PVC pipe (figure 4-15). The lateral taps are joined by tees. They also can be attached by tapping (threading) the manifold pipe, but the manifold pipe must be Schedule 80 to provide a thicker pipe wall for successful tapping. Valves on each pressure tap are recommended to enable each line to be taken out of service as needed by closing the appropriate valve. This allows an opportunity to manage, rest, or repair individual lines. To prevent freezing, the manifold can be drained back to the dose tank after each dose. If this is done, the volume of water that will drain from the manifold and forcemain must be added to the dose volume to achieve the desired dose.

Rigid pipe pressure network

Rigid pipe pressure distribution networks are used to provide relatively uniform distribution of

Figure 4-14. Pressure manifold detail

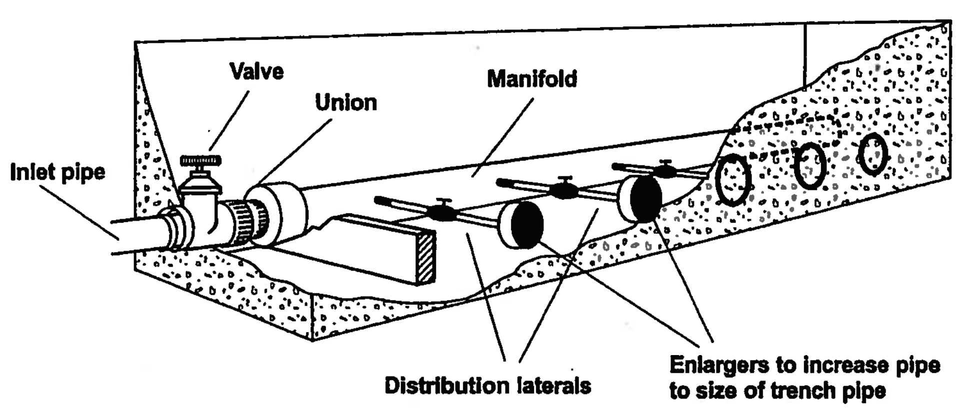
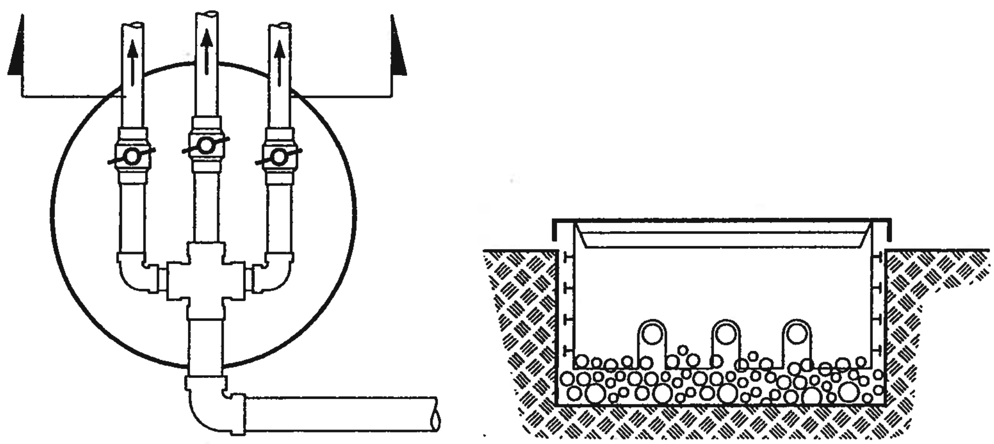


Table 4-7. Pressure manifold sizing

Tap spacing	Manifold size	Single-sided manifold						Double-sided manifold					
		Lateral tap diameter (inches)						Lateral tap diameter (inches)					
(feet)	(inches)	0.50	0.75	1.00	1.25	1.50	2.00	0.50	0.75	1.00	1.25	1.50	2.00
		Maximum number of lateral taps						Maximum number of lateral taps					
0.5	2	4	2					2					
	3	9	5	3	2			4	2				
	4	16	9	5	3	2		7	4	2			
	6	>40	21	12	7	5	3	18	10	6	3	2	
	8		38	22	12	9	5		17	10	6	4	2
3.0	2	8	2					2					
	3	14	12	3	2			6	2				
	4	21	18	6	3	2		16	5	3			
	6	38	30	26	8	5	3	>20	19	7	3	2	
6.0	2	5	4					4					
	3	9	7	6	2			7	3	2			
	4	14	11	9	4	2		10	9	3			
	6	27	20	17	14	7	3	19	15	13	4	3	

Source: Adapted from Berkowitz, 1985.

Figure 4-15. Horizontal design for pressure distribution



Source: Washington Department of Health, 1998.

wastewater effluent over the entire infiltration surface simultaneously during each dose. They are well suited for all dosed systems. Because they deliver the same volume of wastewater effluent per linear length of lateral, they can be used to dose multiple trenches of unequal length. Although rigid pipe pressure networks can be designed to deliver equal volumes to trenches at different elevations (Mote, 1984; Mote et al., 1981; Otis, 1982), these situations should be avoided. Uniform distribution is achieved only when the network is fully pressurized. During filling and draining of the network, the distribution lateral at the lowest elevation receives more water. This disparity increases with increasing dosing frequency. As an alternative on sloping sites, the SWIS could be divided into multiple cells, with the laterals in each cell at the same elevation. If this is not possible, other distribution designs should be considered.

The networks consist of solid PVC pipe manifolds that supply water to a series of smaller perforated PVC laterals (figure 4-16). The laterals are designed to discharge nearly equal volumes of

Pressure manifold design

A SWIS consisting of 12 trenches of equal length is to be constructed on a slope. To divide the septic tank effluent equally among the 12 trenches, a pressure manifold is to be used. The lateral taps are to be spaced 6 inches apart on one side of the manifold.

Table 4-7 can be used to size the manifold. Looking down the series of columns under the Single-sided manifold, up to sixteen ½-inch taps could be made to a 4-inch manifold. Therefore, a 4-inch manifold would be acceptable. If ¾- or 1-inch taps were used, a 6-inch manifold would be necessary.

Using the orifice equation, the flow from each lateral tap can be estimated by assuming an operating pressure in the manifold:

$$Q = Ca(2gh)^2$$

where Q is the lateral discharge rate, C is a dimensionless coefficient that varies with the characteristics of the orifice (0.6 for a sharp-edged orifice), a is the area of the orifice, g is the acceleration due to gravity, and h is the operating pressure within the manifold. In English units using a 0.6 orifice coefficient, this equation becomes

$$Q = 11.79\, d^2 h_d^{1/2}$$

where Q is the discharge rate in gallons per minute, d is the orifice diameter in inches, and h is the operating pressure in feet of water.

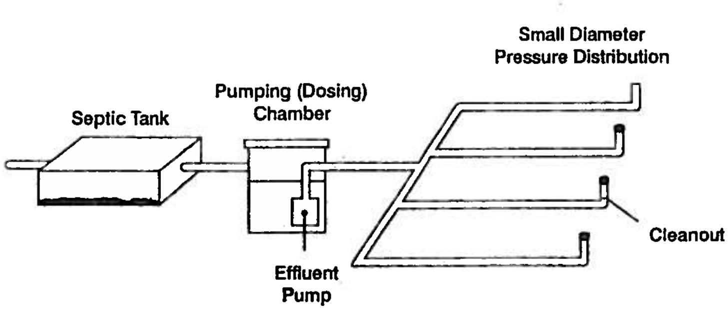
Assuming ½-inch taps with a operating pressure of 3 feet of water, the discharge rate from each outlet is

$$Q = 11.79\,(1/2)^2\, 3^{1/2} = 5.1 \text{ gpm}$$

Thus, the pump must be capable of delivering 12 x 5.1 gpm or approximately 60 gpm against an operating pressure of 3 feet of water plus the static lift and friction losses incurred in the forcemain to the pressure manifold.

wastewater from each orifice in the network when fully pressurized. This is accomplished by maintaining a uniform pressure throughout the network during dosing. The manifolds and laterals are sized relative to the selected orifice size and spacing to achieve uniform pressure. A manual flushing mechanism should be included to enable periodic flushing of slimes and other solids that accumulate in the laterals.

Figure 4-16. Rigid pipe pressure distribution networks with flushing cleanouts



Design of dosed flow systems

A simplified method of network design has been developed (Otis, 1982). Lateral and manifold sizing is determined using a series of graphs and tables after the designer has selected the desired orifice size and spacing and the distal pressure in the network (typically 1 to 2 feet of head). These graphs and tables were derived by calculating the change in flow and pressure at each orifice between the distal and proximal ends of the network. The method is meant to result in discharge rates from the first and last orifices that differ by no more than 10 percent in any lateral and 15 percent across the entire network. However, subsequent testing of field installations indicated that the design model overestimates the maximum lateral length by as much as 25 percent (Converse and Otis, 1982). Therefore, if the graphs and tables are used, the maximum lateral length for any given orifice size and spacing should not exceed 80 percent of the maximum design length suggested by the lateral sizing graphs. In lieu of using the graphs and tables, a spreadsheet could be written using the equations presented and adjusting the orifice discharge coefficient.

Design procedure for rigid pipe pressure distribution network

The simplified design procedure for rigid pipe pressure networks as presented by Otis (1982) includes the following steps:

1. Lay out the proposed network.
2. Select the desired orifice size and spacing. Maximize the density of orifices over the infiltration surface, keeping in mind that the dosing rate increases as the orifice size increases and the orifice spacing decreases.
3. Determine the appropriate lateral pipe diameter compatible with the selected orifice size and spacing using a spreadsheet or sizing charts from Otis (1982).
4. Calculate the lateral discharge rate using the orifice discharge equation (0.48 discharge coefficient or 80 percent of 0.6).
5. Determine the appropriate manifold size based on the number, spacing, and discharge rate of the laterals using a spreadsheet or sizing table from Otis (1982).
6. Determine the dose volume required. Use either the minimum dose volume equal to 5 times the network volume or the expected daily flow divided by the desired dosing frequency, whichever is larger.
7. Calculate the minimum dosing rate (the lateral discharge times the number of laterals).
8. Select the pump based on the required dosing rate and the total dynamic head (sum of the static lift, friction losses in the forcemain to the network, and the network losses, which are equal to 1.3 times the network operating pressure).

To achieve uniform distribution, the density of orifices over the infiltration surface should be as high as possible. However, the greater the number of orifices used, the larger the pump must be to provide the necessary dosing rate. To reduce the dosing rate, the orifice size can be reduced, but the smaller the orifice diameter, the greater the risk of orifice clogging. Orifice diameters as small as 1/8 inch have been used successfully with septic tank effluent when an effluent screen is used at the septic tank outlet. Orifice spacings typically are 1.5 to 4 feet, but the greater the spacing, the less uniform the distribution because each orifice represents a point load. It is up to the designer to achieve the optimum balance between orifice density and pump size.

The dose volume is determined by the desired frequency of dosing and the size of the network. Often, the size of the network will control design. During filling and draining of the network at the start and end of each dose, the distribution is less uniform. The first holes in the network discharge more during initial pressurization of the network, and the holes at the lowest elevation discharge more as the network drains after each dose. To minimize the relative difference in discharge volumes, the dose volume should be greater than five times the volume of the distribution network (Otis, 1982). A pump or siphon can be used to pressurize the network.

Dripline pressure network

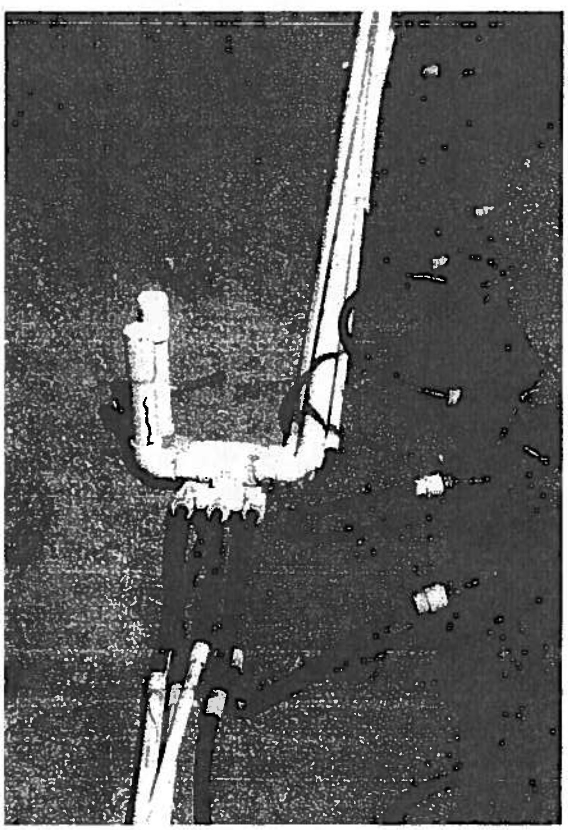
Drip distribution, which was derived from drip irrigation technology, was recently introduced as a method of wastewater distribution. It is a method of pressure distribution capable of delivering small, precise volumes of wastewater effluent to the infiltration surface. It is the most efficient of the distribution methods and is well suited for all types of SWIS applications. A dripline pressure network consists of several components:

- Dose tank
- Pump
- Prefilter
- Supply manifold
- Pressure regulator (when turbulent, flow emitters are used)

- Dripline
- Emitters
- Vacuum release valve
- Return manifold
- Flush valve
- Controller

The pump draws wastewater effluent from the dose tank, preferably on a timed cycle, to dose the distribution system. Before entering the network, the effluent must be prefiltered through mechanical or granular medium filters. The former are used primarily for large SWIS systems. The backflush water generated from a self-cleaning filter should be returned to the headworks of the treatment system. The effluent enters the supply manifold that feeds each dripline (figure 4-17). If turbulent flow emitters are used, the filtered wastewater must first pass through a pressure regulator to control the maximum pressure in the dripline. Usually, the dripline is installed in shallow, narrow trenches 1 to 2 feet apart and only as wide as necessary to insert the dripline using a trenching machine or vibratory plow. The trench is backfilled without any porous medium so that the emitter orifices are in direct contact with the soil. The distal ends of each dripline are connected to a return manifold. The return manifold is used to regularly flush the dripline. To flush, a valve on the manifold is opened and the effluent is flushed through the driplines and returned to the treatment system headworks.

Figure 4-17. Pressure manifold and flexible drip lines prior to trench filling



Source: Ayres Associates.

Because of the unique construction of drip distribution systems, they cause less site disruption during installation, are adaptable to irregularly shaped lots or other difficult site constraints, and use more of the soil mantle for treatment because of the shallow depth of placement. Also, because the installed cost per linear foot of dripline is usually less than the cost of conventional trench construction, dripline can be added to decrease mass loadings to the infiltration surface at lower costs than other distribution methods. Because of the equipment required, however, drip distribution tends to be more costly to construct and requires regular operation and maintenance by knowledgeable individuals. Therefore, it should be considered for use only where operation and maintenance support is ensured.

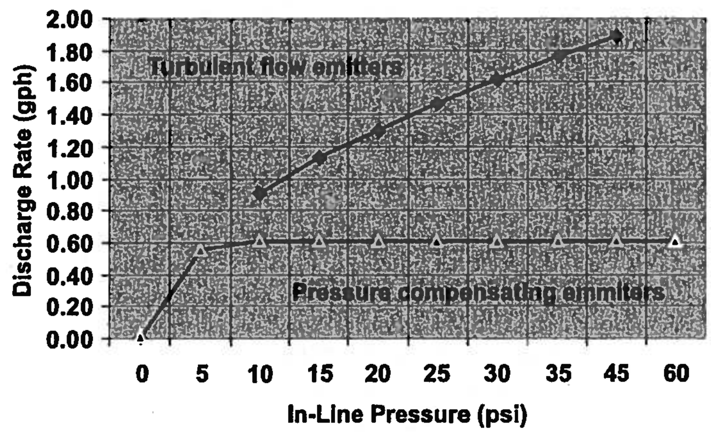
The dripline is normally a ½-inch-diameter flexible polyethylene tube with emitters attached to the inside wall spaced 1 to 2 feet apart along its length. Because the emitter passageways are small, friction losses are large and the rate of discharge is low (typically from 0.5 to nearly 2 gallons per hour).

Two types of emitters are used. One is a "turbulent-flow" emitter, which has a very long labyrinth. Flow through the labyrinth reduces the discharge pressure nearly to atmospheric rates. With increasing in-line pressure, more wastewater can be forced through the labyrinth. Thus, the discharges from turbulent flow emitters are greater at higher pressures (figure 4-18). To more accurately control the rate of discharge, a pressure regulator is installed in the supply manifold upstream of the dripline. Inlet pressures from a minimum of 10 psi to a maximum of 45 psi are recommended. The second emitter type is the pressure-compensating emitter. This emitter discharges at nearly a constant rate over a wide range of in-line pressures (figure 4-18).

Head losses through driplines are high because of the small diameter of the tubing and its in-line emitters, and therefore dripline lengths must be limited. Manufacturers limit lengths at various emitter spacings. With turbulent flow emitters, the discharge from each successive emitter diminishes in response to pressure loss created by friction or by elevation changes along the length of the dripline. With pressure-compensating emitters, the in-line pressure should not drop below 7 to 10 psi at the final emitter. The designer is urged to work with manufacturers to ensure that the system meets their requirements.

Pressure-compensating emitters are somewhat more expensive but offer some important advantages over turbulent-flow emitters for use in onsite wastewater systems. Pressure-compensating dripline is better suited for sloping sites or sites with rolling topography where the dripline cannot be laid on contour. Turbulent-flow emitters discharge more liquid at lower elevations than the same emitters at higher elevations. The designer should limit the difference in discharge rates between emitters to no more than 10 percent. Also, because the discharge rates are equal when under pressure, monitoring flow rates during dosing of a pressure-compensating dripline network can provide an effective way to determine whether leaks or obstructions are present in the network or emitters. Early detection is important so that simple and effective corrective actions can be taken. Usually, injection of a mild bleach solution into the dripline is effective in restoring emitter performance if clogging is due to biofilms. If this action proves to be unsuccessful, other corrective actions are more difficult and costly. An additional advantage of pressure-compensating emitters is that pressure regulators are not required. Finally, when operating in their normal pressure range, pressure-compensating emitters are not affected by soil water pressure in structured soils, which can cause turbulent-flow emitters to suffer reduced dosing volumes.

Figure 4-18. Turbulent-flow and pressure-compensating emitter discharge rates versus in-line pressure



Controlling clogging in drip systems

With small orifices, emitters are susceptible to clogging. Particulate materials in the wastewater, soil particulates drawn into an emitter when the dripline drains following a dose, and biological slimes that grow within the dripline pose potential clogging problems. Also, the moisture and nutrients discharged from the emitters may invite root intrusion through the emitter. Solutions to these problems lie in both the design of the dripline and the design of the distribution network. Emitter hydrodynamic design and biocide impregnation of the dripline and emitters help to minimize some of these problems. Careful network design is also necessary to provide adequate safeguards. Monitoring allows the operator to identify other problems such as destruction from burrowing animals.

To control emitter clogging, appropriate engineering controls must be provided. These include prefiltration of the wastewater, regular dripline flushing, and vacuum release valves on the network. Prefiltration of the effluent through granular or mechanical filters is necessary. These filters should be capable of removing all particulates that could plug the emitter orifices. Dripline manufacturers recommend that self-cleaning filters be designed to remove particles larger than 100 to 115 microns. Despite this disparate experience, pretreatment with filters is recommended in light of the potential cost of replacing plugged emitters. Regular cleaning of the filters is necessary to maintain satisfactory performance. The backflush water should be returned to the head of the treatment works.

The dripline must be flushed on a regular schedule to keep it scoured of solids. Flushing is accomplished by opening the flush valve on the return manifold and increasing the pumping rate to achieve scouring velocity. Each supplier recommends a velocity and procedure for this process. The flushing rate and volume must include water losses (discharge) through the emitters during the flushing event. Both continuous flushing and timed flushing are used. However, flushing can add a significant hydraulic load to the treatment system and must be considered in the design. If intermittent flushing is practiced, flushing should be performed at least monthly.

Aspiration of soil particles is another potential emitter clogging hazard. Draining of the network following a dosing cycle can create a vacuum in the network. The vacuum can cause soil particles to be aspirated into the emitter orifices. To prevent this from occurring, vacuum relief valves are used. It is best to install these at the high points of both the supply and return manifolds.

Placement and layout of drip systems

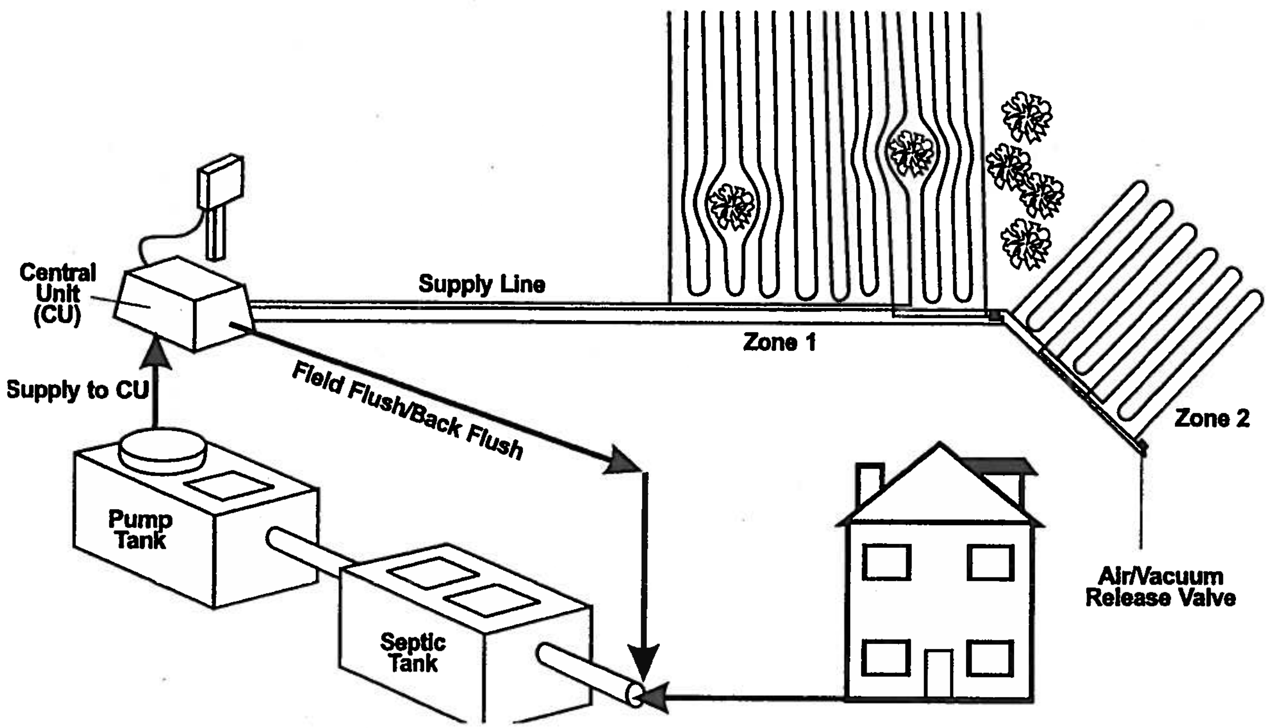
When drip distribution was introduced, the approach to sizing SWISs using this distribution method was substantially different from that for SWISs using other distribution methods. Manufacturer-recommended hydraulic loading rates were expressed in terms of gallons per day per square foot of drip distribution footprint area. Typically, the recommended rates were based on 2-foot emitter and dripline spacing. Therefore, each emitter would serve 4 square feet of footprint area. Because the dripline is commonly plowed into the soil without surrounding it with porous medium, the soil around the dripline becomes the actual infiltration surface. The amount of infiltration surface provided is approximately 2/3 to 1 square foot per 5 linear feet of dripline. As a result, the wastewater loading rate is considerably greater than the hydraulic loadings recommended for traditional SWISs. Experience has shown however, that the hydraulic loading on this surface can be as much as seven times higher than that of traditional SWIS designs (Ayres Associates, 1994). This is probably due to the very narrow geometry, higher levels of pretreatment, shallow placement, and intermittent loadings of the trenches, all of which help to enhance reaeration of the infiltration surface.

The designer must be aware of the differences between the recommended hydraulic loadings for drip distribution and those customarily used for traditional SWISs. The recommended drip distribution loadings are a function of the soil, dripline spacing, and applied effluent quality. It is necessary to express the hydraulic loading in terms of the footprint area because the individual dripline trenches are not isolated infiltration surfaces. If the emitter and/or dripline spacing is reduced, the wetting fronts emanating from each emitter could overlap and significantly reduce hydraulic performance. Therefore, reducing the emitter and/or dripline spacing should not reduce the overall required system footprint. Reducing the spacing might be beneficial for irrigating small areas of turf grass, but the maximum daily emitter discharge must be reduced proportionately by adding more dripline to maintain the same footprint size. Using higher hydraulic loading rates must be carefully considered in light of secondary boundary loadings, which could result in excessive ground water mounding (see chapter 5). Further, the instantaneous hydraulic loading during a dose must be controlled because storage is not provided in the dripline trench. If the dose volume is too high, the wastewater can erupt at the ground surface.

Layout of the drip distribution network must be considered carefully. Two important consequences of the network layout are the impacts on dose pump sizing necessary to achieve adequate flushing flows and the extent of localized overloading due to internal dripline drainage. Flushing flow rates are a function of the number of manifold/dripline connections: More connections create a need for greater flushing flows, which require a larger pump. To minimize the flushing flow rate, the length of each dripline should be made as long as possible in accordance with the manufacturer's recommendations. To fit the landscape, the dripline can be looped between the supply and return manifolds (figure 4-19). Consideration should also be given to dividing the network into more than one cell to reduce the number of connections in an individual network. A computer program has been developed to evaluate and optimize the hydraulic design for adequate flushing flows of dripline networks that use pressure-compensating emitters (Berkowitz and Harman, 1994).

Internal drainage that occurs following each dose or when the soils around the dripline are saturated

Figure 4-19. Dripline layout on a site with trees



Source: Adapted from American Manufacturing, 2001.

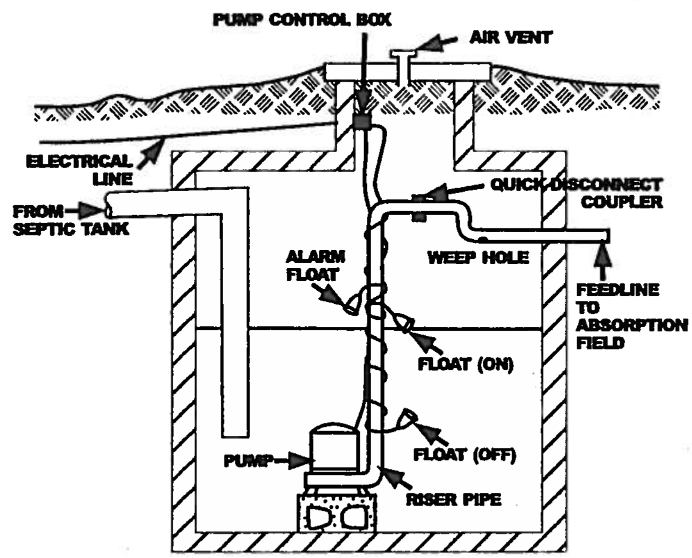
can cause significant hydraulic overloading to lower portions of the SWIS. Following a dose cycle, the dripline drains through the emitters. On sloping sites, the upper driplines drain to the lower driplines, where hydraulic overloading can occur. Any free water around the dripline can enter through an emitter and drain to the lowest elevation. Each of these events needs to be avoided as much as possible through design. The designer can minimize internal drainage problems by isolating the driplines from each other in a cell, by aligning the supply and return manifolds with the site's contours. A further safeguard is to limit the number of doses per day while keeping the instantaneous hydraulic loadings to a minimum so the dripline trench is not flooded following a dose. This trade-off is best addressed by determining the maximum hydraulic loading and adjusting the number of doses to fit this dosing volume.

Freezing of dripline networks has occurred in severe winter climates. Limited experience indicates that shallow burial depths together with a lack of uncompacted snow cover or other insulating materials might lead to freezing. In severe winter climates, the burial depth of dripline should be increased appropriately and a good turf grass established over the network. Mulching the area the winter after construction or every winter should be considered. Also, it is good practice to install the vacuum release valves below grade and insulate the air space around them. Although experience with drip distribution in cold climates is limited, these safeguards should provide adequate protection.

Dosing methods

Two methods of dosing have been used (table 4-6). With on-demand dosing, the wastewater effluent rises to a preset level in the dose tank and the pump or siphon is activated by a float switch or other mechanism to initiate discharge (figure 4-20). During peak-flow periods, dosing is frequent with little time between doses for the infiltration system to drain and the subsoil to reaerate. During low-flow periods, dosing intervals are long, which can be beneficial in controlling biomat development but is inefficient in using the hydraulic capacity of the system.

Figure 4-20. Pumping tank (generic)



Source: Purdue University, 1990

Timed dosing overcomes some of the shortcomings of on-demand dosing. Timers are used to turn the pump on and off at specified intervals so that only a predetermined volume of wastewater is discharged with each dose. Timed dosing has two distinct advantages over on-demand dosing. First, the doses can be spaced evenly over the entire 24-hour day to optimize the use of the soil's treatment capacity. Second, the infiltration system receives no more than its design flow each day. Clear water infiltration, leaking plumbing fixtures, or excessive water use are detected before the excess flow is discharged to the infiltration system because the dose tank will eventually fill to its high water alarm level. At that point, the owner has the option of calling a septage pumper to empty the tanks or activating the pump to dose the system until the problem is diagnosed and corrected. Unlike on-demand dosing, timed dosing requires that the dose tank be sized to store peak flows until they can be pumped (see sidebar).

Dosing frequency and volume are two important design considerations. Frequent, small doses are preferred over large doses one or two times per day. However, doses should not be so frequent that distribution is poor. This is particularly true with either of the pressure distribution networks. With pressure networks, uniform distribution does not occur until the entire network is pressurized. To ensure pressurization and to minimize unequal discharges from the orifices during filling and draining, a dose volume equal to five times the network volume is a good rule of thumb. Thus, doses can be smaller and more frequent with dripline networks than with rigid pipe networks because the volume of drip distribution networks is smaller.

4.4.8 SWIS media

A porous medium is placed below and around SWIS distribution piping to expand the infiltration surface area of the excavation exposed to the applied wastewater. This approach is similar in most SWIS designs, except when drip distribution or aggregate-free designs are used. In addition, the medium also supports the excavation sidewalls, provides storage of peak wastewater flows, minimizes erosion of the infiltration surface by dissipating the energy of the influent flow, and provides some protection for the piping from freezing and root penetration.

Traditionally, washed gravel or crushed rock, typically ranging from ¾ to 2½ inches in diameter, has been used as the porous medium. The rock should be durable, resistant to slaking and dissolution, and free of fine particles. A hardness of at least 3 on the Moh's scale of hardness is suggested. Rock that can scratch a copper penny without leaving any residual meets this criterion. It is important that the medium be washed to remove fine particles. Fines from insufficiently washed rock have been shown to result in significant reductions in infiltration rates (Amerson et al., 1991). In all applications where gravel is used, it must be properly graded and washed. Improperly washed gravel can contribute fines and other material that can plug voids in the infiltrative surface and reduce hydraulic capability. Gravel that is embedded into clay or fine soils during placement can have the same effect.

In addition to natural aggregates, gravelless systems have been widely used as alternative SWIS medium (see preceding section). These systems take many forms, including open-bottomed chambers, fabric-wrapped pipe, and synthetic materials such as expanded polystyrene foam chips, as described in the preceding section. Systems that provide an open chamber are sometimes referred to as "aggregate-free" systems, to distinguish them from others that substitute lightweight medium for gravel or stone. These systems provide a suitable substitute in locales where gravel is not available or affordable. Some systems (polyethylene chambers and light-

Dose tank sizing for timed dosing

Timed dosing to a SWIS is to be used in an onsite system serving a restaurant in a summer resort area. Timed dosing will equalize the flows, enhancing treatment in the soil and reducing the required size of the SWIS.

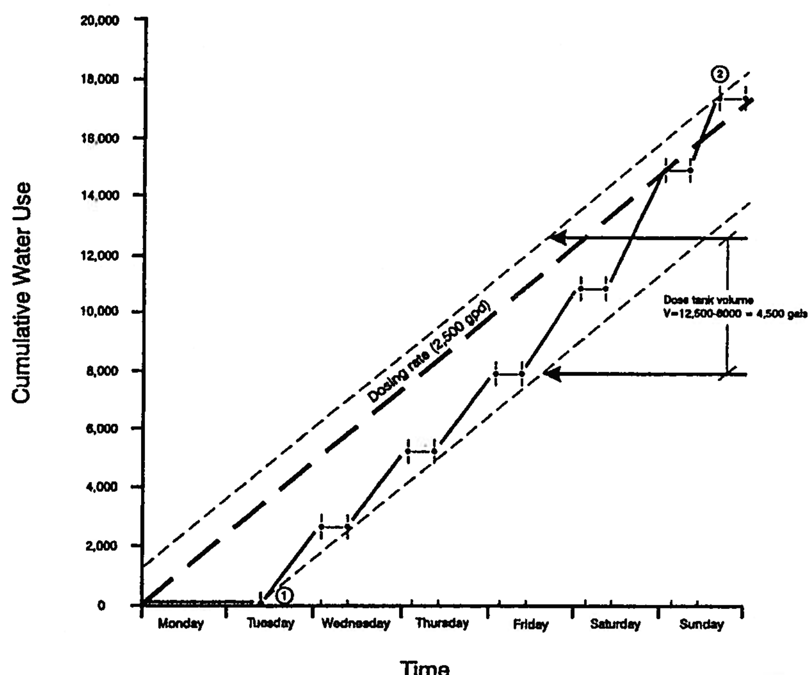
The restaurant serves meals from 11 a.m. to 12 midnight Tuesday through Saturday and from 9 a.m. to 2 p.m. Sundays. The largest number of meals is served during the summer weekends. The restaurant is closed on Mondays. The metered water use is as follows:

Average weekly water use (summer)	17,500 gal
Peak weekend water use (4 p.m. Friday to 2 p.m. Sunday)	9,500 gal

The dose tank will be sized to equalize flows over a 7-day period. The dosing frequency is to be six times daily or one dose every 4 hours. Therefore, the dose volume will be

Dose volume = 17,500 gal/wk ¸ (7 d/wk x 6 doses/day) = 417 gal/dose

The necessary volume of the dose tank to store the peak flows and equalize the flow to the SWIS over the 7-day week can be determined graphically.



Source: Ayres Associates.

The accumulated water use over the week and the daily dosing rate (6 doses/day x 417 gal/dose = 2,500 gpd) is plotted on the graph. Lines parallel to the dosing rate are drawn tangent to points 1 and 2 representing the maximum deviations of the water use line above and below the dosing rate line. The volume represented by the difference between the two parallel lines is the tank volume needed to achieve flow equalization. A 4,500-gallon tank would be required.

Both siphons and pumps can be used for dosing distribution networks. Only drip distribution networks cannot be dosed by siphons because of the higher required operating pressures and the need to control instantaneous hydraulic loadings (dose volume). Siphons can be used where power is not available and elevation is adequate to install the siphon sufficiently above the distribution network to overcome friction losses in the forcemain and network. Care must be taken in their selection and installation to ensure proper performance. Also, owners must be aware that siphon systems require routine monitoring and occasional maintenance. "Dribbling" can occur when the siphon bell becomes saturated, suspending dosing and allowing the wastewater effluent to trickle out under the bell. Dribbling can occur because of leaks in the bell or a siphon out of adjustment. Today, pumps are favored over siphons because of the greater flexibility in site selection and dosing regime.

weight aggregate systems) can also offer substantial advantages in terms of reduced site disruption over the traditional gravel because their light weight makes them easy to handle without the use of heavy equipment. These advantages reduce labor costs, limit damage to the property by machinery, and allow construction on difficult sites where conventional medium could not reasonably be used.

4.5 Construction management and contingency options

Onsite wastewater systems can and do fail to perform at times. To avoid threats to public health and the environment during periods when a system malfunctions hydraulically, contingency plans should be made to permit continued use of the system until appropriate remedial actions can be taken. Contingency options should be considered during design so that the appropriate measures are designed into the original system. Table 4-8 lists common contingency options.

4.5.1 Construction considerations

Construction practices are critical to the performance of SWISs. Satisfactory SWIS performance depends on maintaining soil porosity. Construction activities can significantly reduce the porosity and cause SWISs to hydraulically fail soon after being brought into service. Good construction practices should carefully consider site protection before and during construction, site preparation, and construction equipment selection and use. Good construction practices for at-grade and mound systems can be found elsewhere (Converse and Tyler, 2000; Converse et al., 1990). Many of them, however, are similar to those described in the following subsections.

Site protection

Construction of the onsite wastewater system is often only one of many construction activities that occur on a property. If not protected against intrusion, the site designated for the onsite system can be damaged by other, unrelated construction

Table 4-8. Contingency options for SWIS malfunctions

Contingency option	Description	Comments
Reserve area	Unencumbered area of suitable soils set aside for a future replacement system.	Does not provide immediate relief from performance problems because the replacement system must be constructed. The replacement system should be constructed such that use can be alternated with use of the original system.
Multiple cells	Two or more infiltration cells with a total hydraulic capacity of 100% to 200% of the required area that are alternated into service.	Provide immediate relief from performance problems by providing stand-by capacity. Rotating cells in and out of service on an annual or other regular schedule helps to maintain system capacity. Alternating valves are commercially available to implement this option. The risk from performance problems is reduced because the malfunction of a single cell involves a smaller proportion of the daily flow.
Water conservation	Water-conserving actions taken to reduce the hydraulic load to the system, which may alleviate the problem.	A temporary solution that may necessitate a significant lifestyle change by the residents, which creates a disincentive for continued implementation. The organic loading will remain the same unless specific water uses or waste inputs are eliminated from the building or the wastewaters are removed from the site.
Pump and haul	Conversion of the septic tank to a holding tank that must be periodically pumped. The raw waste must be hauled to a suitable treatment and/or disposal site.	Holding tanks are a temporary or permanent solution that can be effective but costly, creating a disincentive for long-term use.

activities. Therefore, the site should be staked and roped off before any construction activities begin to make others aware of the site and to keep traffic and materials stockpiles off the site.

The designer should anticipate what activities will be necessary during construction and designate acceptable areas for them to occur. Site access points and areas for traffic lanes, material stockpiling, and equipment parking should be designated on the drawings for the contractor.

Site preparation

Site preparation activities include clearing and surface preparation for filling. Before these activities are begun, the soil moisture should be determined. In nongranular soils, compaction will occur if the soil is near its plastic limit. This can be tested by removing a sample of soil and rolling it between the palms of the hands. If the soil fails to form a "rope" the soil is sufficiently dry to proceed. However, constant care should be taken to avoid soil disturbance as much as possible.

Clearing

Clearing should be limited to mowing and raking because the surface should be only minimally disturbed. If trees must be removed, they should be cut at the base of the trunk and removed without heavy machinery. If it is necessary to remove the stumps, they should be ground out. Grubbing of the site (mechanically raking away roots) should be avoided. If the site is to be filled, the surface should be moldboard- or chisel-plowed parallel to the contour (usually to a depth of 7 to 10 inches) when the soil is sufficiently dry to ensure maximum vertical permeability. The organic layer should not be removed. Scarifying the surface with the teeth of a backhoe bucket is not sufficient.

Excavation

Excavation activities can cause significant reductions in soil porosity and permeability (Tyler et al., 1985). Compaction and smearing of the soil infiltrative surface occur from equipment traffic and vibration, scraping actions of the equipment, and placement of the SWIS medium on the infiltration surface. Lightweight backhoes are most commonly used. Front-end loaders and blades should not be used because of their scraping action. All efforts should be made to avoid any disturbance to the exposed infiltration surface. Equipment should be kept off the infiltration field. Before the SWIS medium is installed, any smeared areas should be scarified and the surface gently raked. If gravel or crushed rock is to be used for SWIS medium, the rock should be placed in the trench by using the backhoe bucket rather than dumping it directly from the truck. If damage occurs, it might be possible to restore the area, but only by removing the compacted layer. It might be necessary to remove as much as 4 inches of soil to regain the natural soil porosity and permeability (Tyler et al., 1985). Consequences of the removal of this amount of soil over the entire infiltration surface can be significant. It will reduce the separation distance to the restrictive horizon and could place the infiltration surface in an unacceptable soil horizon.

To avoid potential soil damage during construction, the soil below the proposed infiltration surface elevation must be below its plastic limit. This should be tested before excavation begins. Also, excavation should be scheduled only when the infiltration surface can be covered the same day to avoid loss of permeability from wind-blown silt or raindrop impact. Another solution is to use lightweight gravelless systems, which reduce the damage and speed the construction process.

Before leaving the site, the area around the site should be graded to divert surface runoff from the SWIS area. The backfill over the infiltration surface should be mounded slightly to account for settling and eliminate depressions over the system that can pond water. Finally, the area should be seeded and mulched.

4.5.2 Operation, maintenance, and monitoring

Subsurface wastewater infiltration systems require little operator intervention. Table 4-9 lists typical operation, maintenance, and monitoring activities that should be performed. However, more complex pretreatment, larger and more variable flows, and higher-risk installations increase the need for maintenance and monitoring. More information is provided in the USEPA draft *Guidelines for Onsite/Decentralized Wastewater Systems* (2000) and in the chapter 4 fact sheets.

Table 4-9. Operation, maintenance, and monitoring activities

Task	Description	Frequency
Water meter reading	Recommended for large, commercial systems	Daily
Dosing tank controls	Check function of pump, switches, and timers for pressure-dosed systems	Monthly
Pump calibration	Check pumping rate and adjust dose timers as appropriate for pressure-dosed systems	Annually
Infiltration cell rotation	Direct wastewater to standby cells to rest operating cells	Annually (optimally in the spring)
Infiltration surface ponding	Record wastewater ponding depths over the infiltration surface and switch to standby cell when ponding persists for more than a month	Monthly
Inspect surface and perimeter of SWIS	Walk over SWIS area to observe surface ponding or other signs of stress or damage	Monthly
Tank solids levels and integrity assessment	Check for sludge and scum accumulation, condition of baffles and inlet and outlet appurtenances, and potential leaks	Varies with tank size and management program

4.5.3 Considerations for large and commercial systems

Designs for systems treating larger flows follow the same guidelines used for residential systems, but they must address characteristics of the wastewater to be treated, site characteristics, infiltration surface sizing, and contingency planning more comprehensively.

Wastewater characteristics

Wastewaters from cluster systems serving multiple homes or commercial establishments can differ substantially in flow pattern and waste strength from wastewaters generated by single family residences. The ratio of peak to average daily flow from residential clusters is typically much lower than what is typical from single residences. This is because the moderating effect associated with combining multiple water use patterns reduces the daily variation in flow. Commercial systems, on the other hand, can vary significantly in wastewater strength. Typically, restaurants have high concentrations of grease and BOD, laundromats have high sodium and suspended solids concentrations, and toilet facilities at parks and rest areas have higher concentrations of BOD, TSS, and nitrogen. These differences in daily flow patterns and waste strengths must be dealt with in the design of SWISs. Therefore, it is important to characterize the wastewater fully before initiating design (see chapter 3).

Site characteristics

The proposed site for a SWIS that will treat wastewater from a cluster of homes or a commercial establishment must be evaluated more rigorously than a single-residence site because of the larger volume of water that is to be applied and the greater need to determine hydraulic gradients and direction. SWIS discharges can be from 10 to more than 100 times the amount of water that the soil infiltration surface typically receives from precipitation. For example, assume that an area receives an average of 40 inches of rainfall per year. Of that, less than 25 percent (about 10 inches annually) infiltrates and even less percolates to the water table. A wastewater infiltration system is designed to infiltrate 0.4 to 1.6 inches per day, or 146 to 584 inches per year. Assuming actual system flows are 30 percent of design flows, this is reduced to 44 to 175 inches per year even under this conservative approach.

The soils associated with small systems can usually accommodate these additional flows. However, systems that treat larger flows load wastewaters to the soil over a greater area and might exceed the site's capacity to accept the wastewater. Restrictive horizons that may inhibit deep percolation need to be identified before design. Ground water mounding analysis should be performed to determine whether the hydraulic loading to the saturated zone (secondary design boundary), rather than the loading to the infiltration surface, controls system sizing (see Chapter 5). If the secondary boundary controls design, the size of the infiltration surface, its geometry, and even how wastewater is applied will be affected.

Infiltration surface sizing

Selection of the design flow is a very important consideration in infiltration surface sizing. State codified design flows for residential systems typically are 2 to 5 times greater than the average daily flow actually generated in the home. This occurs because the design flow is usually based on the number of bedrooms rather than the number of occupants. As a result, the actual daily flow is often a small fraction of the design flow.

This is not the case when the per capita flows for the population served or metered flows are used as the design flow. In such instances, the ratio of design flow to actual daily flow can approach unity. This is because the same factors of safety are typically not used to determine the design flow. In itself, this is not a problem. The problem arises when the metered or averaged hydraulic loading rates are used to size the infiltration surface. These rates can be more than two times what the soil below the undersized system is actually able to accept. As a result, SWISs would be significantly undersized. This problem is exacerbated where the waste strength is high.

To avoid the problem of undersizing the infiltration surface, designs must compensate in some way. Factors of safety of up to 2 or more could be applied to accurate flow estimates, but the more common practice is to design multiple cells that provide 150 to 200 percent of the total estimated infiltration surface needed. Multiple cells are a good approach because the cells can be rotated into service on a regular schedule that allows the cells taken out of service to rest and rejuvenate their hydraulic capacity. Further, the system provides standby capacity that can be used when malfunctions occur, and distribution networks are smaller to permit smaller and more frequent dosing, thereby maximizing oxygen transfer and the hydraulic capacity of the site. For high-strength wastewaters, advanced pretreatment can be specified or the infiltration surface loadings can be adjusted (see *Special Issue Fact Sheet 4*).

Contingency planning

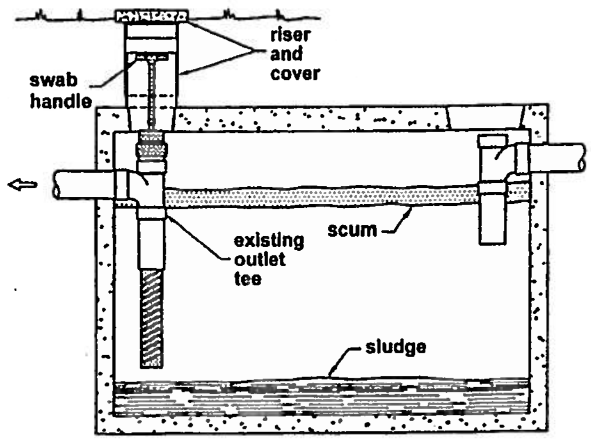
Malfunctions of systems that treat larger flows can create significant public health and environmental hazards. Therefore, adequate contingency planning is more critical for these systems than for residential systems. Standby infiltration cells, timed dosing, and flow monitoring are key design elements that should be included. Also, professional management should be required.

4.6 Septic tanks

The septic tank is the most commonly used wastewater pretreatment unit for onsite wastewater systems. Tanks may be used alone or in combination with other processes to treat raw wastewater before it is discharged to a subsurface infiltration system. The tank provides primary treatment by creating quiescent conditions inside a covered, watertight rectangular, oval, or cylindrical vessel, which is typically buried. In addition to primary treatment, the septic tank stores and partially digests settled and floating organic solids in sludge and scum layers. This can reduce the sludge and scum volumes by as much as 40 percent, and it conditions the wastewater by hydrolyzing organic molecules for subsequent treatment in the soil or by other unit processes (Baumann et al., 1978). Gases generated from digestion of the organics are vented back through the building sewer and out of the house plumbing stack vent. Inlet structures are designed to limit short circuiting of incoming wastewater across the tank to the outlet, while outlet structures (e.g., a sanitary "tee" fitting) retain the sludge and scum layers in the tank and draw effluent only from the clarified zone between the sludge and scum layers. The outlet should be fitted with an effluent screen (commonly called a septic tank filter) to retain larger solids that might be carried in the effluent to the SWIS, where it could contribute to clogging and eventual system failure. Inspection ports and manways are provided in the tank cover to allow access for periodically removing the tank contents, including the accumulated scum and sludge (figure 4-21). A diagram of a two-compartment tank is shown later in this section.

Septic tanks are used as the first or only pretreatment step in nearly all onsite systems regardless of

Figure 4-21. Profile of a single-compartment septic tank with outlet screen



daily wastewater flow rate or strength. Other mechanical pretreatment units may be substituted for septic tanks, but even when these are used septic tanks often precede them. The tanks passively provide suspended solids removal, solids storage and digestion, and some peak flow attenuation.

4.6.1 Treatment

A septic tank removes many of the settleable solids, oils, greases, and floating debris in the raw wastewater, achieving 60 to 80 percent removal (Baumann et al., 1978; Boyer and Rock, 1992; University of Wisconsin, 1978). The solids removed are stored in sludge and scum layers, where they undergo liquefaction. During liquefaction, the first step in the digestion process, acid-forming bacteria partially digest the solids by hydrolyzing the proteins and converting them to volatile fatty acids, most of which are dissolved in the water phase. The volatile fatty acids still exert much of the biochemical oxygen demand that was originally in the organic suspended solids. Because these acids are in the dissolved form, they are able to pass from the tank in the effluent stream, reducing the BOD removal efficiency of septic tanks compared to primary sedimentation. Typical septic tank BOD removal efficiencies are 30 to 50 percent (Boyer and Rock, 1992; University of Wisconsin, 1978; see table 4-10). Complete digestion, in which the volatile fatty acids are converted to methane, could reduce the amount of BOD released by the tank, but it usually does not occur to a significant extent because wastewater temperatures in septic tanks are typically well below the optimum temperature for methane-producing bacteria.

Gases that form from the microbial action in the tank rise in the wastewater column. The rising gas bubbles disturb the quiescent wastewater column, which can reduce the settling efficiency of the tank. They also dislodge colloidal particles in the sludge blanket so they can escape in the water column. At the same time, however, they can carry active anaerobic and facultative microorganisms that might help to treat colloidal and dissolved solids present in the wastewater column (Baumann and Babbit, 1953).

Septic tank effluent varies naturally in quality depending on the characteristics of the wastewater and condition of the tank. Documented effluent quality from single-family homes, small communities and cluster systems, and various commercial septic tanks is presented in tables 4-10 through 4-12.

Table 4-10. Characteristics of domestic septic tank effluent

Parameter	University of Wis. (1978)	Harkin, et al. (1979)	Ronayne, et al. (1982)	Ayres Associates (1993)	Ayres Associates (1996)
No. tanks sampled	7	33	8	8	1
Location	Wisconsin	Wisconsin	Oregon	Florida	Florida
(No. samples)	(150)	(140 - 215)	(56)	(36)	(3)
BOD_5 (mg/L)	138	132	217	141	179
COD (mg/L)	327	445	—	—	—
TSS (mg/L)	49	87	146	161	59
TKN (mgN/L)	45	82	57.1	39	66
TP (mgP/l)	13	21.8	—	11	17
Oil/Grease (mg/L)	—	—	—	36	37
Fecal coliforms (log#/L)	4.6	6.5	6.4	5.1-8.2	7.0

Table 4-11. Average septic tank effluent concentrations for selected parameters from small community and cluster systems

Parameter	Westboro, WI[a]	Bend, OR[b]	Glide, OR[c]	Manila, CA[d]	College Sta., TX[e]
BOD_5 (mg/L)	168	157	118	189	--
COD (mg/L)	338	276	228	284	266
TSS (mg/L)	85	36	52	75	--
TN (mgN/L)	63.4	41	50	--	29.5
TP (mgP/L)	8.1	--	--	--	8.2
Oil/Grease (mg/L)	--	65	16	22	--
Fecal coliforms (log#/L)	7.3	--	--	--	6.0
pH	6.9–7.4	6.4–7.2	6.4–7.2	6.5–7.8	7.4
Flow (gpcd)	36	40–60	48	40–57	--

[a] Small-diameter gravity sewer serving a small community collecting septic tank effluent from 90 connections (Otis, 1978).
[b] Pressure sewer collecting septic tank effluent from eleven homes (Bowne, 1982).
[c] Pressure sewer collecting septic tank effluent from a small community (Bowne, 1982).
[d] Pressure sewer serving a small community collecting septic tank effluent from 330 connections (Bowne, 1982).
[e] Effluent from one septic tank accepting wastewater from nine homes (Brown et al., 1977).

Table 4-12. Average septic tank effluent concentrations of selected parameters from various commercial establishments[a]

Wastewater Type	BOD_5 (mg/L)	COD (mg/L)	TSS (mg/L)	TKN (mgN/L)	TP (mgP/L)	Oil/Grease (mg/L)	Temp (°C)	pH
Restaurant A	582	1196	187	82	24	101	8–22	5.6–6.4
Restaurant B	245	622	65	64	14	40	8–22	6.6–7.0
Restaurant C	880	1667	372	71	23	144	13–23	5.8–6.3
Restaurant D	377	772	247	30	15	101	16–21	5.7–6.8
Restaurant E	693	1321	125	78	28	65	4–26	5.5–6.9
Restaurant F	261	586	66	73	19	47	7–25	5.8–7.0
Motel	171	381	66	34	20	45	20–28	6.5–7.1
Country Club A	197	416	56	36	13	24	6–20	6.5–6.8
Country Club B	333	620	121	63	17	46	13–26	6.2–6.8
Country Club C	101	227	44	36	10	33	10–23	6.2–7.4
Bar/Grill	179	449	79	61	7	49	8–22	6.0–7.0

[a] Averages based on 2 to 9 grab samples depending on the parameter taken between March and September 1983.
Source: Siegrist et al., 1985.

4.6.2 Design considerations

The primary purpose of a septic tank is to provide suspended solids and oil/grease removal through sedimentation and flotation. The important factor to achieving good sedimentation is maintaining quiescent conditions. This is accomplished by providing a long wastewater residence time in the septic tank. Tank volume, geometry, and compartmentalization affect the residence time.

Volume

Septic tanks must have sufficient volume to provide an adequate hydraulic residence time for sedimentation. Hydraulic residence times of 6 to 24 hours have been recommended (Baumann and Babbitt, 1953: Kinnicutt et al., 1910). However, actual hydraulic residence times can vary significantly from tank to tank because of differences in geometry, depth, and inlet and outlet configurations (Baumann and Babbitt, 1953). Sludge and scum also affect the residence time, reducing it as the solids accumulate.

Table 4-13. Septic tank capacities for one- and two-family dwellings (ICC, 1995).

Number of bedrooms	Septic tank volume (gallons)
1	750*
2	750*
3	1,000
4	1,200
5	1,425
6	1,650
7	1,875
8	2,100

* Many states have established 1,000 gallons or more as the minimum size.

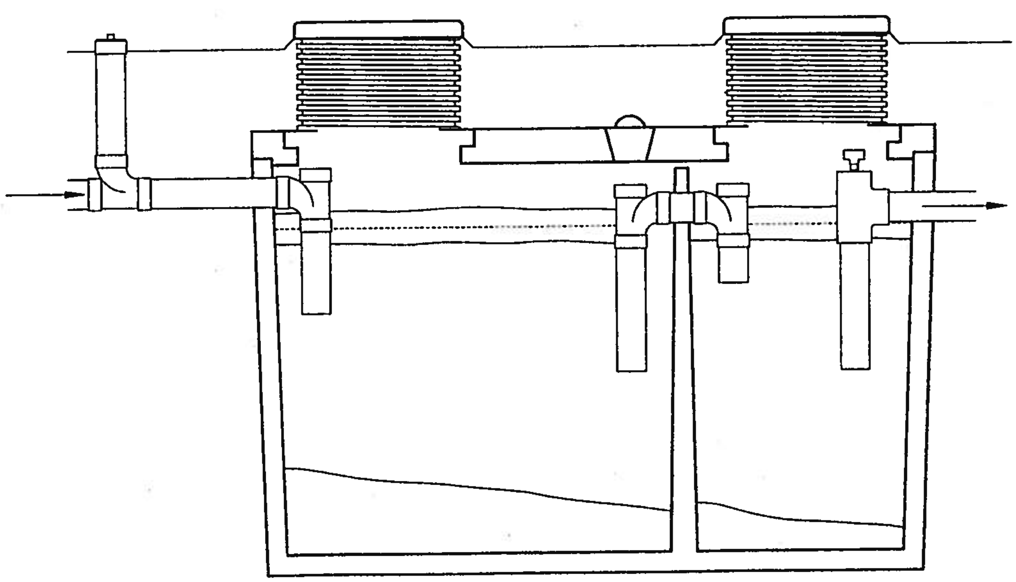
Most state and national plumbing codes specify the tank volume to be used based on the building size or estimated peak daily flow of wastewater. Table 4-13 presents the tank volumes recommended in the International Private Sewage Disposal Code specified for one- and two-family residences (ICC, 1995). The volumes specified are typical of most local codes, but in many jurisdictions the minimum tank volume has been increased to 1,000 gallons or more. For buildings other than one- or two-family residential homes, the rule of thumb often used for sizing tanks is to use two to three times the estimated design flow. This conservative rule of thumb is based on maintaining a 24-hour minimum hydraulic retention time when the tank is ready for pumping, for example, when the tank is one-half to two-thirds full of sludge and scum.

Geometry

Tank geometry affects the hydraulic residence time in the tank. The length-to-width ratio and liquid depth are important considerations. Elongated tanks with length-to-width ratios of 3:1 and greater have been shown to reduce short-circuiting of the raw wastewater across the tank and improve suspended solids removal (Ludwig, 1950). Prefabricated tanks generally are available in rectangular, oval, and cylindrical (horizontal or vertical) shapes. Vertical cylindrical tanks can be the least effective because of the shorter distance between the inlets and outlets. Baffles are recommended.

Among tanks of equal liquid volumes, the tank with shallower liquid depths better reduces peak outflow rates and velocities, so solids are less likely to remain in suspension and be carried out of the tank in the effluent. This is because the shallow tank has a larger surface area. Inflows to the tank cause less of a liquid rise because of the larger surface area. The rate of flow exiting the tank (over a weir or through a pipe invert) is propor-

Figure 4-22. Two-compartment tank with effluent screen and surface risers



Source: Washington Department of Health, 1998.

tional to the height of the water surface over the invert (Baumann et al., 1978; Jones, 1975). Also, the depth of excavation necessary is reduced with shallow tanks, which helps to avoid saturated horizons and lessens the potential for ground water infiltration or tank flotation. A typically specified minimum liquid depth below the outlet invert is 36 inches. Shallower depths can disturb the sludge blanket and, therefore, require more frequent pumping.

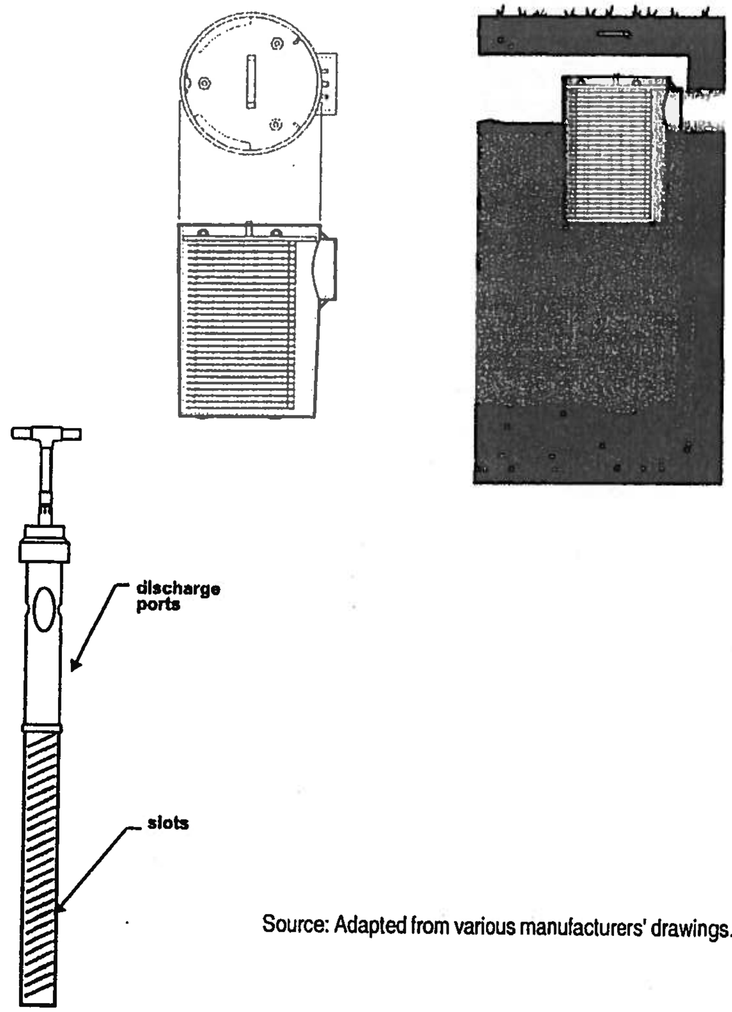
Compartmentalization

Compartmentalized tanks (figure 4-23) or tanks placed in series provide better suspended solids removal than single-compartment tanks alone, although results from different studies vary (Baumann and Babbitt, 1953; Boyer and Rock, 1992; Weibel et al., 1949, 1954; University of Wisconsin, 1978). If two compartments are used, better suspended solids removal rates are achieved if the first compartment is equal to one-half to two-thirds the total tank volume (Weibel et al., 1949, 1954). An air vent between compartments must be provided to allow both compartments to vent. The primary advantage of these configurations is when gas generated from organic solids digestion in the first compartment is separated from subsequent compartments.

Inlets and outlets

The inlet and outlet of a septic tank are designed to enhance tank performance. Their respective invert elevations should provide at least a 2- to 3-inch drop across the tank to ensure that the building sewer does not become flooded and obstructed during high wastewater flows (figure 4-24). A clear space of at least 9 inches should be provided above the liquid depth (outlet invert) to allow for scum storage and ventilation. Both the inlet and outlet are commonly baffled. Plastic sanitary tees are the most commonly used baffles. Curtain baffles (concrete baffles cast to the tank wall and fiberglass or plastic baffles bolted to the tank wall) have also been used. The use of gasket materials that achieve a watertight joint with the tank wall makes plastic sanitary tees easy to adjust, repair, or equip with effluent screens or filters. The use of a removable, cleanable effluent screen connected to the outlet is strongly recommended.

Figure 4-23. Examples of septic tank effluent screens/filters



Source: Adapted from various manufacturers' drawings.

The inlet baffle is designed to prevent short-circuiting of the flow to the outlet by dissipating the energy of the influent flow and deflecting it downward into the tank. The rising leg of the tee should extend at least 6 inches above the liquid level to prevent the scum layer from plugging the inlet. It should be open at the top to allow venting of the tank through the building sewer and out the plumbing stack vent. The descending leg should extend well into the clear space between the sludge and scum layers, but not more than about 30 to 40 percent of the liquid depth. The volume of the descending leg should not be larger than 2 to 3 gallons so that it is completely flushed to expel floating materials that could cake the inlet. For this reason, curtain baffles should be avoided.

The outlet baffle is designed to draw effluent from the clear zone between the sludge and scum layers. The rising leg of the tee should extend 6 inches above the liquid level to prevent the scum layer from escaping the tank. The descending leg should extend to 30 or 40 percent of the liquid depth. Effluent screens (commonly called septic tank filters), which can be fitted to septic tank outlets, are commercially available. Screens prevent solids that either are buoyant or are resuspended from the scum or sludge layers from passing out of the tank (figures 4-22 and 4-23). Mesh, slotted screens, and stacked plates with openings from 1/32 to 1/8 inch are available. Usually, the screens can be fitted into the existing outlet tee or retrofitted directly into the outlet. An access port directly above the outlet is required so the screen can be removed for inspection and cleaning.

Quality-assured, reliable test results have not shown conclusively that effluent screens result in effluents with significantly lower suspended solids and BOD concentrations. However, they provide an excellent, low-cost safeguard against neutral-buoyancy solids and high suspended solids in the tank effluent resulting from solids digestion or other upsets. Also, as the effluent screens clog over time, slower draining and flushing of home fixtures may alert homeowners of the need for maintenance before complete blockage occurs.

Tank access

Access to the septic tank is necessary for pumping septage, observing the inlet and outlet baffles, and servicing the effluent screen. Both manways and inspection ports are used. Manways are large openings, 18 to 24 inches in diameter or square. At least one that can provide access to the entire tank for septage removal is needed. If the system is compartmentalized, each compartment requires a manway. They are located over the inlet, the outlet, or the center of the tank. Typically, in the past manway covers were required to be buried under state and local codes. However, they should be above grade and fitted with an airtight, lockable cover so they can be accessed quickly and easily. Inspection ports are 8 inches or larger in diameter and located over both the inlet and the outlet unless a manway is used. They should be extended above grade and securely capped.

(CAUTION: The screen should not be removed for inspection or cleaning without first plugging the outlet or pumping the tank to lower the liquid level below the outlet invert. Solids retained on the screen can slough off as the screen is removed. These solids will pass through the outlet and into the SWIS unless precautions are taken. This caution should be made clear in homeowner instructions and on notices posted at the access port.)

Septic tank designs for large wastewater flows do not differ from designs for small systems. However, it is suggested that multiple compartments or tanks in series be used and that effluent screens be attached to the tank outlet. Access ports and manways should be brought to grade and provided with locking covers for all large systems.

Construction materials

Septic tanks smaller than 6,000 gallons are typically premanufactured; larger tanks are constructed in place. The materials used in premanufactured tanks include concrete, fiberglass, polyethylene, and coated steel. Precast concrete tanks are by far the most common, but fiberglass and plastic tanks are gaining popularity. The lighter weight fiberglass and plastic tanks can be shipped longer distances and set in place without cranes. Concrete tanks, on the other hand, are less susceptible to collapse and flotation. Coated steel tanks are no longer widely used because they corrode easily. Tanks constructed in place are typically made of concrete.

Tanks constructed of fiberglass-reinforced polyester (FRP) usually have a wall thickness of about 1/4 inch (6 millimeters). Most are gel- or resin-coated to provide a smooth finish and prevent glass fibers from becoming exposed, which can cause wicking. Polyethylene tanks are more flexible than FRP tanks and can deform to a shape of structural weakness if not properly designed. Concrete tank walls are usually about 4 inches thick and reinforced with no. 5 rods on 8-inch (20-centimeter) centers. Sulfuric acid and hydrogen sulfide, both of which are present in varying concentrations in septic tank effluent, can corrode exposed rods and the concrete itself over time. Some plastics (e.g., polyvinyl chloride, polyethylene, but not nylon) are virtually unaffected by acids and hydrogen sulfide (USEPA, 1991).

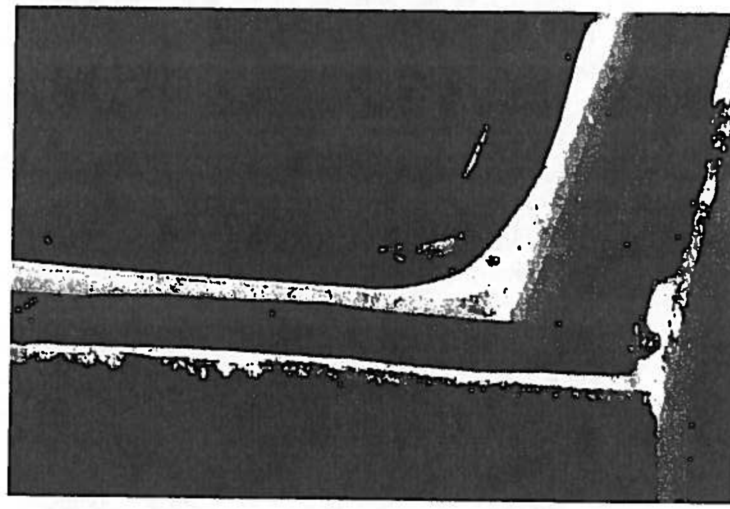
Quality construction is critical to proper performance. Tanks must be properly designed, reinforced, and constructed of the proper mix of materials so they can meet anticipated loads without cracking or collapsing. All joints must be watertight and flexible to accommodate soil conditions. For concrete tank manufacturing, a "best practices manual" can be purchased from the National Pre-Cast Concrete Association (NPCA, 1998). Also, a *Standard Specification for Precast Concrete Septic Tanks* (C 1227) has been published by the American Society for Testing and Materials (ASTM, 1998).

Watertightness

Watertightness of the septic tank is critical to the performance of the entire onsite wastewater system. Leaks, whether exfiltrating or infiltrating, are serious. Infiltration of clear water to the tank from the building storm sewer or ground water adds to the hydraulic load of the system and can upset subsequent treatment processes. Exfiltration can threaten ground water quality with partially treated wastewater and can lower the liquid level below the outlet baffle so it and subsequent processes can become fouled with scum. Also, leaks can cause the tank to collapse.

Tank joints should be designed for watertightness. Two-piece tanks and tanks with separate covers should be designed with tongue and groove or lap joints (figure 4-24). Manway covers should have similar joints. High-quality, preformed joint sealers should be used to achieve a watertight seal. They should be workable over a wide temperature range and should adhere to clean, dry surfaces; they must not shrink, harden, or oxidize. Seals should meet the minimum compression and other requirements prescribed by the seal manufacturer. Pipe and inspection port joints should have cast-in rubber boots or compression seals.

Figure 4-24. Tongue and groove joint and sealer



Source: Ayres Associates

Septic tanks should be tested for watertightness using hydrostatic or vacuum tests, and manway risers and inspection ports should be included in the test. The professional association representing the materials industry of the type of tank construction (e.g., the National Pre-cast Concrete Association) should be contacted to establish the appropriate testing criteria and procedures. Test criteria for precast concrete are presented in table 4-14.

4.6.3 Construction considerations

Important construction considerations include tank location, bedding and backfilling, watertightness, and flotation prevention, especially with non-concrete tanks. Roof drains, surface water runoff, and other clear water sources must not be routed to the septic tank. Attention to these considerations

Table 4-14. Watertightness testing procedure/criteria for precast concrete tanks

Standard	Hydrostatic test		Vacuum test	
	Preparation	Pass/fail criterion	Preparation	Pass/fail criterion
C 1227, ASTM (1993)	Seal tank, fill with water, and let stand for 24 hours. Refill tank.	Approved if water level is held for 1 hour	Seal tank and apply a vacuum of 2 in. Hg.	Approved if 90% of vacuum is held for 2 minutes.
NPCA (1998)	Seal tank, fill with water, and let stand for 8 to 10 hours. Refill tank and let stand for another 8 to 10 hours.	Approved if no further measurable water level drop occurs	Seal tank and apply a vacuum of 4 in. Hg. Hold vacuum for 5 minutes. Bring vacuum back to 4 in. Hg.	Approved if vacuum can be held for 5 minutes without a loss of vacuum.

will help to ensure that the tank performs as intended.

Location

The tank should be located where it can be accessed easily for septage removal and sited away from drainage swales or depressions where water can collect. Local codes must be consulted regarding minimum horizontal setback distances from buildings, property boundaries, wells, water lines, and the like.

Bedding and backfilling

The tank should rest on a uniform bearing surface. It is good practice to provide a level, granular base for the tank. The underlying soils must be capable of bearing the weight of the tank and its contents. Soils with a high organic content or containing large boulders or massive rock edges are not suitable.

After setting the tank, leveling, and joining the building sewer and effluent line, the tank can be backfilled. The backfill material should be free-flowing and free of stones larger than 3 inches in diameter, debris, ice, or snow. It should be added in lifts and each lift compacted. In fine-textured soils such as silts, silt loams, clay loams, and clay, imported granular material should be used. This is a must where freeze and thaw cycles are common because the soil movement during such cycles can work tank joints open. This is a significant concern when using plastic and fiberglass tanks.

The specific bedding and backfilling requirements vary with the shape and material of the tank. The manufacturer should be consulted for acceptable materials and procedures.

Watertightness

All joints must be sealed properly, including tank joints (sections and covers if not a monolithic tank), inlets, outlets, manways, and risers (ASTM, 1993; NPCA, 1998). The joints should be clean and dry before applying the joint sealer. Only high-quality joint sealers should be used (see previous section). Backfilling should not proceed until the sealant setup period is completed. After all joints have been made and have cured, a watertightness test should be performed (see table 4-14 for precast concrete tanks). Risers should be tested.

Flotation prevention

If the tank is set where the soil can be saturated, tank flotation may occur, particularly when the tank is empty (e.g., recently pumped dose tanks or septic tank after septage removal). Tank manufacturers should be consulted for appropriate antiflotation devices.

4.6.4 Operation and maintenance

The septic tank is a passive treatment unit that typically requires little operator intervention. Regular inspections, septage pumping, and periodic cleaning of the effluent filter or screen are the only operation and maintenance requirements. Commercially available microbiological and enzyme additives are promoted to reduce sludge and scum accumulations in septic tanks. They are not necessary for the septic tank to function properly when treating domestic wastewaters. Results from studies to evaluate their effectiveness have failed to prove their cost-effectiveness for residential application. For most products, concentrations of suspended solids and BOD in the septic tank effluent increase upon their use, posing a threat to SWIS performance. No additive made up of organic solvents or strong alkali chemicals should be used because they pose a potential threat to soil structure and ground water.

Inspections

Inspections are performed to observe sludge and scum accumulations, structural soundness, watertightness, and condition of the inlet and outlet baffles and screens. *(Warning: In performing inspections or other maintenance, the tank should not be entered. The septic tank is a confined space and entering can be extremely hazardous because of toxic gases and/or insufficient oxygen.)*

Sludge and scum accumulations

As wastewater passes through and is partially treated in the septic tank over the years, the layers of floatable material (scum) and settleable material (sludge) increase in thickness and gradually reduce the amount of space available for clarified wastewater. If the sludge layer rises to the bottom of the effluent T-pipe, solids can be drawn through the effluent port and transported into the infiltration field, increasing the risk of clogging. Likewise, if the bottom of the thickening scum layer moves lower than the bottom of the effluent T-pipe, oils and other scum material can be drawn into the piping that discharges to the infiltration field. Various devices are commercially available to measure sludge and scum depths. The scum layer should not extend above the top or below the bottom of either the inlet or outlet tees. The top of the sludge layer should be at least 1 foot below the bottom of either tee or baffle. Usually, the sludge depth is greatest below the inlet baffle. The scum layer bottom must not be less than 3 inches above the bottom of the outlet tee or baffle. If any of these conditions are present, there is a risk that wastewater solids will plug the tank inlet or be carried out in the tank effluent and begin to clog the SWIS.

Structural soundness and watertightness

Structural soundness and watertightness are best observed after the septage has been pumped from the tank. The interior tank surfaces should be inspected for deterioration, such as pitting, spalling, delamination, and so forth and for cracks and holes. The presence of roots, for example, indicates tank cracks or open joints. These observations should be made with a mirror and bright light. Watertightness can be checked by observing the liquid level (before pumping), observing all joints for seeping water or roots, and listening for running or dripping water. Before pumping, the liquid level of the tank should be at the outlet invert level. If the liquid level is below the outlet invert, exfiltration is occurring. If it is above, the outlet is obstructed or the SWIS is flooded. A constant trickle from the inlet is an indication that plumbing fixtures in the building are leaking and need to be inspected.

Baffles and screens

The baffles should be observed to confirm that they are in the proper position, secured well to the piping or tank wall, clear of debris, and not cracked or broken. If an effluent screen is fitted to the outlet baffle, it should be removed, cleaned, inspected for irregularities, and replaced. Note that effluent screens should not be removed until the tank has been pumped or the outlet is first plugged.

Septic tank pumping

Tanks should be pumped when sludge and scum accumulations exceed 30 percent of the tank volume or are encroaching on the inlet and outlet baffle entrances. Periodic pumping of septic tanks is recommended to ensure proper system performance and reduce the risk of hydraulic failure. If systems are not inspected, septic tanks should be pumped every 3 to 5 years depending on the size of the tank, the number of building occupants, and household appliances and habits (see Special Issues Fact Sheets). Commercial systems should be inspected and/or pumped more frequently, typically annually. There is a system available that provides continuous monitoring and data storage of changes in the sludge depth, scum or grease layer thickness, liquid level, and temperature in the tank. Long-term verification studies of this system are under way. Accumulated sludge and scum material stored in the tank should be removed by a certified, licensed, or trained service provider and reused or disposed of in accordance with applicable federal, state, and local codes. (Also see section 4.5.5.)

4.6.5 Septage

Septage is an odoriferous slurry (solids content of only 3 to 10 percent) of organic and inorganic material that typically contains high levels of grit, hair, nutrients, pathogenic microorganisms, oil, and grease (table 4-15). Septage is defined as the entire contents of the septic tank—the scum, the sludge, and the partially clarified liquid that lies between them—and also includes pumpings from aerobic treatment unit tanks, holding tanks, biological ("composting") toilets, chemical or vault toilets, and other systems that receive domestic wastewaters. Septage is controlled under the federal regulations at 40 CFR Part 503. Publications and other information on compliance with these regulations can be found at **http://www.epa.gov/oia/tips/scws.htm**.

Septage also may harbor potentially toxic levels of metals and organic and inorganic chemicals. The exact composition of septage from a particular treatment system is highly dependent upon the type of facility and the activities and habits of its users.

Table 4-15. Chemical and physical characteristics of domestic septage

Parameter	Concentration (mg/L)	
	Average	Range
Total solids	34,106	1,132–130,475
Total volatile solids	23,100	353–71,402
Total suspended solids	12,862	310–93,378
Volatile suspended solids	9,027	95–51,500
Biochemical oxygen demand	6,480	440–78,600
Chemical oxygen demand	31,900	1,500–703,000
Total Kjeldahl nitrogen	588	66–1,060
Ammonia nitrogen	97	3–116
Total phosphorus	210	20–760
Alkalinity	970	522–4,190
Grease	5,600	208–23,368
pH	—	1.5–12.6

Source: USEPA, 1994.

For example, oil and grease levels in septage from food service or processing facilities might be many times higher than oil and grease concentrations in septage from residences (see Special Issues Fact Sheets). Campgrounds that have separate graywater treatment systems for showers will likely have much higher levels of solids in the septage from the blackwater (i.e., toilet waste) treatment system. Septage from portable toilets might have been treated with disinfectants, deodorizers, or other chemicals.

Septage management programs

The primary objective of a septage management program is to establish procedures and rules for handling and disposing of septage in an affordable manner that protects public health and ecological resources. When planning a program it is important to have a thorough knowledge of legal and regulatory requirements regarding handling and disposal. USEPA (1994) has issued regulations and guidance that contain the type of information required for developing, implementing, and maintaining a septage management program. Detailed guidance for identifying, selecting, developing, and operating reuse or disposal sites for septage is provided in *Process Design Manual: Surface Disposal of Sewage Sludge and Domestic Septage* (USEPA, 1995[b]), which is on the Internet at **http://www.epa.gov/ORD/WebPubs/sludge.pdf**. Additional information can be found in *Domestic Septage Regulatory Guidance* (USEPA, 1993), at **http://www.epa.gov/oia/tips/scws.htm**.

States and municipalities typically establish public health and environmental protection regulations for septage management (pumping, handling, transport, treatment, and reuse/disposal). Key components of septage management programs include tracking or manifest systems that identify acceptable septage sources, pumpers, transport equipment, final destination, and treatment, as well as procedures for controlling human exposure to septage, including vector control, wet weather runoff, and access to disposal sites.

Septage treatment/disposal: land application

The ultimate fate of septage generally falls into three basic categories—land application, treatment at a wastewater treatment plant, or treatment at a special septage treatment plant. Land application is the most commonly used method for disposing of septage in the United States. Simple and cost-effective, land application approaches use minimal energy and recycle organic material and nutrients back to the land. Topography, soils, drainage patterns, and agricultural crops determine which type of land disposal practice works best for a given situation. Some common alternatives are surface application, subsurface incorporation, and burial. Disposal of portable toilet wastes mixed with disinfectants, deodorizers, or other chemicals at land application sites is not recommended. If possible, these wastes should be delivered to the collection system of a wastewater treatment plant to avoid potential chemical contamination risks at septage land application sites. Treatment plant operators should be consulted so they can determine when and where the septage should be added to the collection system.

When disposing of septage by land application, appropriate buffers and setbacks should be provided between application areas and water resources (e.g., streams, lakes, sinkholes). Other considerations include vegetation type and density, slopes, soils, sensitivity of water resources, climate, and application rates. Agricultural products from the site must not be directly consumed by humans. Land application practices include the following:

Spreading by hauler truck or farm equipment

In the simplest method, the truck that pumps the septage takes it to a field and spreads it on the soil. Alternatively, the hauler truck can transfer its septage load into a wagon spreader or other specialized spreading equipment or into a holding facility at the site for spreading later.

Spray irrigation

Spray irrigation is an alternative that eliminates the problem of soil compaction by tires. Pretreated septage is pumped at 80 to 100 psi through nozzles and sprayed directly onto the land. This method allows for septage disposal on fields with rough terrain.

Ridge and furrow irrigation

Pretreated septage can be transferred directly into furrows or row crops. The land should be relatively level.

Subsurface incorporation of septage

This alternative to surface application involves placing untreated septage just below the surface. This approach reduces odors and health risks while still fertilizing and conditioning the soil. The method can be applied only on relatively flat land (less than 8 percent slope) in areas where the seasonally high water table is at least 20 inches. Because soil compaction is a concern, no vehicles should be allowed to drive on the field for 1 to 2 weeks after application. Subsurface application practices include the following:

- *Plow and furrow irrigation:* In this simple method, a plow creates a narrow furrow 6 to 8 inches (15 to 20 centimeters) deep. Liquid septage is discharged from a tank into the furrow, and a second plow covers the furrow.
- *Subsurface injection:* A tillage tool is used to create a narrow cavity 4 to 6 inches (10 to 15 centimeters) deep. Liquid septage is injected into the cavity, and the hole is covered.

Codisposal of septage in sanitary landfills

Because of the pollution risks associated with runoff and effluent leaching into ground water, landfill disposal of septage is not usually a viable option. However, some jurisdictions may allow disposal of septage/soil mixtures or permit other special disposal options for dewatered septage (sludge with at least 20 percent solids). Septage or sludge deposited in a landfill should be covered immediately with at least 6 inches of soil to control odors and vector access (USEPA, 1995b). *(Note: Codisposal of sewage sludge or domestic septage at a municipal landfill is considered surface disposal and is regulated under 40 CFR Part 258.)*

Septage treatment/disposal: treatment plants

Disposal of septage at a wastewater treatment plant is often a convenient and cost-effective option. Addition of septage requires special care and handling because by nature septage is more concentrated than the influent wastewater stream at the treatment plant. Therefore, there must be adequate capacity at the plant to handle and perhaps temporarily store delivered septage until it can be fed into the treatment process units. Sites that typically serve as the input point for septage to be treated at a wastewater treatment plant include the following:

Upstream sewer manhole

This alternative is viable for larger sewer systems and treatment plants. Septage is added to the normal influent wastewater flow at a receiving station fitted with an access manhole.

Treatment plant headworks

The septage is added at the treatment plant upstream of the inlet screens and grit chambers. The primary concern associated with this option is the impact of the introduced wastes on treatment unit processes in the plant. A thorough analysis should be conducted to ensure that plant processes can accept and treat the wastes while maintaining appropriate effluent pollutant concentrations and meeting other treatment requirements. In any event, the treatment plant operator should be consulted before disposal.

Sludge-handling process

To reduce loading to the liquid stream, the septage can be sent directly to the sludge-handling process. Like the headworks option, the impact on the sludge treatment processes must be carefully analyzed to ensure that the final product meets treatment and other requirements.

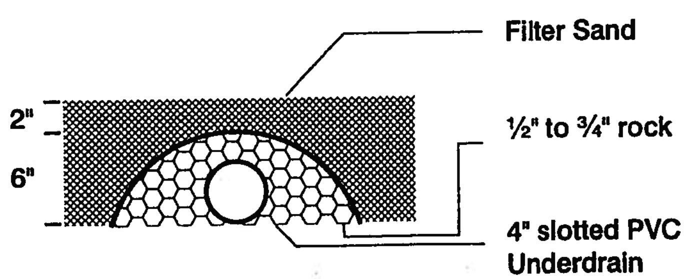
Treatment at a special septage treatment plant

This method of septage disposal is usually employed in areas where land disposal or treatment at a wastewater treatment plant is not a feasible option. There are few of these facilities, which vary from simple lagoons to sophisticated plants that mechanically and/or chemically treat septage. Treatment processes used include lime stabilization, chlorine oxidation, aerobic and anaerobic digestion, composting, and dewatering using pressure or vacuum filtration or centrifugation. This is the most expensive option for septage management and should be considered only as a last resort.

Public outreach and involvement

Developing septage treatment units or land application sites requires an effective public outreach program. Opposition to locating these facilities in the service area is sometimes based about incomplete or inaccurate information, fear of the unknown, and a lack of knowledge on potential impacts. Without an effective community-based program of involvement, even the most reasonable plan can be difficult to implement. Traditional guidance on obtaining public input in the development of disposal or reuse facilities can be found in *Process Design Manual: Surface Disposal of Sewage Sludge and Domestic Septage* (USEPA, 1995b), which is on the Internet at **http://www.epa.gov/ORD/WebPubs/sludge.pdf**.

Figure 4-25. Underdrain system detail for sand filters



Additional information can be found in *Domestic Septage Regulatory Guidance* (USEPA, 1993), posted at **http://www.epa.gov/oia/tips/scws.htm**. General guidance on developing and implementing a public outreach strategy is available in *Getting In Step: A Guide to Effective Outreach in Your Watershed*, published by the Council of State Governments (see chapter 2) and available at **http://www.epa.gov/owow/watershed/outreach/documents/**.

4.7 Sand/media filters

Sand (or other media) filters are used to provide advanced treatment of settled wastewater or septic tank effluent. They consist of a lined (lined with impervious PVC liner on sand bedding) excavation or watertight structure filled with uniformly sized washed sand (the medium) that is normally placed over an underdrain system (figure 4-25). These contained media filters are also known as packed bed filters. The wastewater is dosed onto the surface of the sand through a distribution network and is allowed to percolate through the sand to the underdrain system. The underdrain collects the filtrate for further processing, recycling, or discharging to a SWIS. Some "bottomless" designs directly infiltrate the filtered effluent into the soil below.

4.7.1 Treatment mechanisms and filter design

Sand filters are essentially aerobic, fixed-film bioreactors used to treat septic tank effluent. Other very important treatment mechanisms that occur in sand filters include physical processes such as straining and sedimentation, which remove suspended solids within the pores of the media, and chemical adsorption of dissolved pollutants (e.g., phosphorus) to media surfaces. The latter phenomenon tends to be finite because adsorption sites become saturated with the adsorbed compound, and it is specific to the medium chosen. Bioslimes from the growth of microorganisms develop as attached films on the sand particle surfaces. The microorganisms in the slimes absorb soluble and colloidal waste materials in the wastewater as it percolates around the sand surfaces. The absorbed materials are incorporated into new cell mass or degraded under aerobic conditions to carbon dioxide and water.

Most of the biochemical treatment occurs within approximately 6 inches (15 centimeters) of the filter surface. As the wastewater percolates through this active layer, carbonaceous BOD and ammonium-nitrogen are removed. Most of the suspended solids are strained out at the filter surface. The BOD is nearly completely removed if the wastewater retention time in the sand media is sufficiently long for the microorganisms to absorb and react with waste constituents. With depleting carbonaceous BOD in the percolating wastewater, nitrifying microorganisms are able to thrive deeper in this active surface layer, where nitrification will readily occur.

To achieve acceptable treatment, the wastewater retention time in the filter must be sufficiently long and reaeration of the media must occur to meet the oxygen demand of the applied wastewater. The pore size distribution and continuity of the filter medium, the dose volume, and the dosing frequency are key design and operating considerations for achieving these conditions. As the effective size and uniformity of the media increases, the reaeration rate increases, but the retention time decreases. Treatment performance might decline if the retention time is too short. If so, it may be necessary to recirculate the wastewater through the filter several times to achieve the desired retention time and concomitant treatment performance. Multiple small dose volumes that do not create a saturated wetting front on the medium can be used to extend residence times. If saturated conditions are avoided, moisture tensions within the medium will remain high, which will redistribute the applied wastewater throughout the medium, enhancing its contact with the bioslimes on the medium. The interval between doses provides time for reaeration of the medium to replenish the oxygen depleted during the previous dose.

Filter surface clogging can occur with finer media in response to excessive organic loadings. Biomass increases can partially fill the pores in the surface layer of the sand. If the organic loadings are too great, the biomass will increase to a point where the surface layer becomes clogged and is unable to accept further wastewater applications. However, if the applied food supply is less than that required by resident microorganisms, the microorganisms are forced into endogenous respiration; that is, they begin to draw on their stored metabolites or surrounding dead cells for food. If the microorganisms are maintained in this growth phase, net increases of biomass do not occur and clogging can be minimized.

Chemical adsorption can occur throughout the medium bed, but adsorption sites in the medium are usually limited. The capacity of the medium to retain ions depends on the target constituent, the pH, and the mineralogy of the medium. Phosphorus is one element of concern in wastewater that can be removed in this manner, but the number of available adsorption sites is limited by the characteristics of the medium. Higher aluminum, iron, or calcium concentrations can be used to increase the effectiveness of the medium in removing phosphorus. Typical packed bed sand filters are not efficient units for chemical adsorption over an extended period of time. However, use of special media can lengthen the service (phosphorus removal) life of such filters beyond the normal, finite period of effective removal.

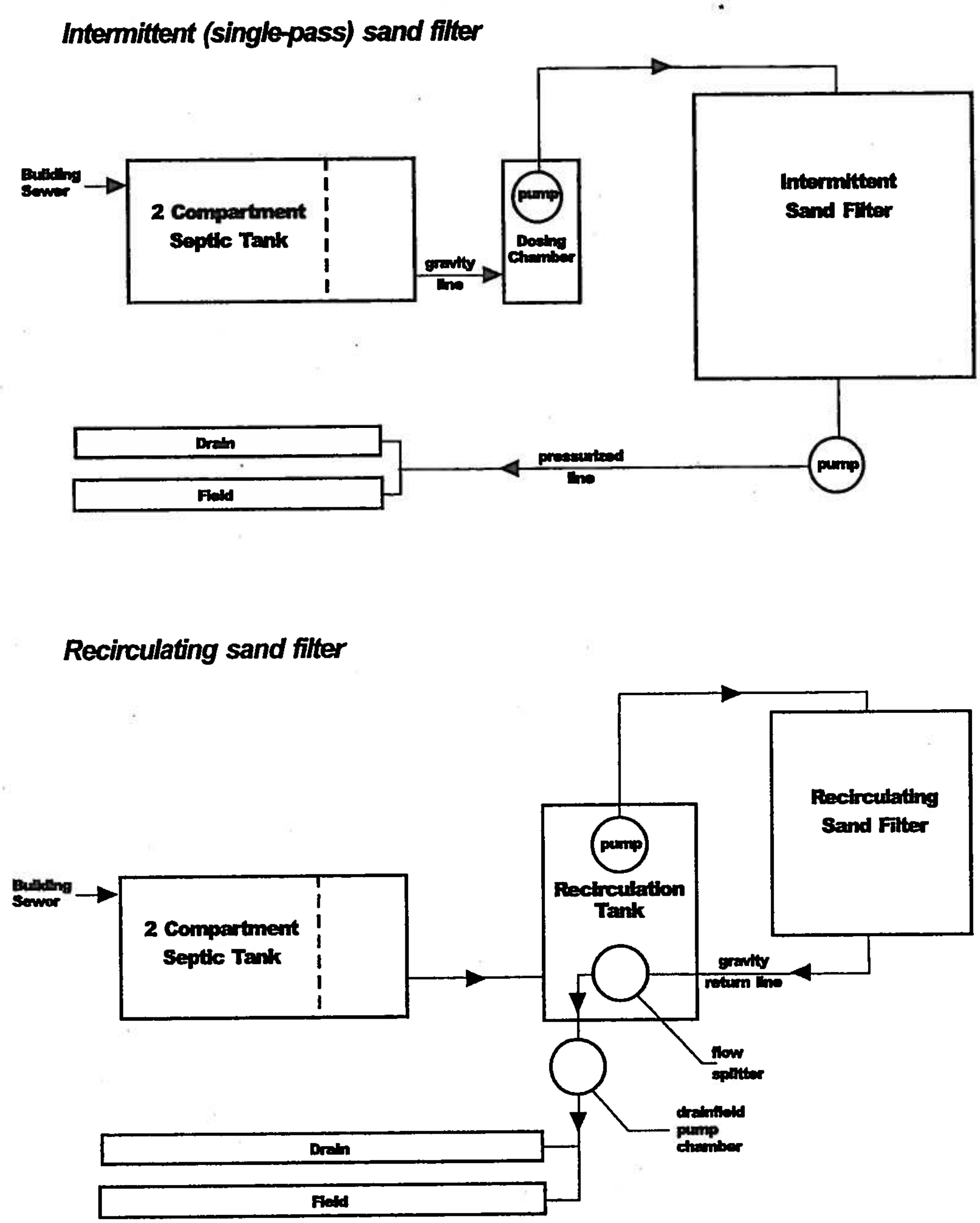
Filter designs

Sand filters are simple in design and relatively passive to operate because the fixed-film process is very stable and few mechanical components are used. Two types of filter designs are common, "single-pass" and "recirculating" (figure 4-26). They are similar in treatment mechanisms and performance, but they operate differently. Single-pass filters, historically called "intermittent" filters, discharge treated septic tank effluent after one pass through the filter medium (see Fact Sheet 10). Recirculating filters collect and recirculate the filtrate through the filter medium several times before discharging it (see Fact Sheet 11). Each has advantages for different applications.

Single-pass filters

The basic components of single-pass filters (see Fact Sheet 10) include a dose tank, pump and controls (or siphon), distribution network, and the filter bed with an underdrain system (figure 4-25). The wastewater is intermittently dosed from the dose tank onto the filter through the distribution network. From there, it percolates through the sand medium to the underdrain and is discharged. On-demand dosing has often been used, but timed dosing is becoming common.

Figure 4-26. Schematics of the two most common types of sand media filters



To create the wastewater retention times necessary for achieving desired treatment results, single-pass filters must use finer media than that typically used in recirculating filters. Finely sized media results in longer residence times and greater contact between the wastewater and the media surfaces and their attached bioslimes. BOD removals of greater than 90 percent and nearly complete ammonia removal are typical (Darby et al., 1996; Emerick et al., 1997; University of Wisconsin, 1978). Single-pass filters typically achieve greater fecal coliform removals than recirculating filters because of the finer media and the lower hydraulic loading. Daily hydraulic loadings are typically limited to 1 to 2 gpd/ft^2, depending on sand size, organic loading, and especially the number of doses per day (Darby et al., 1996).

Recirculating filters

The basic components of recirculating filters (see Fact Sheet 11) are a recirculation/dosing tank, pump and controls, a distribution network, a filter bed with an underdrain system, and a return line fitted with a flow-splitting device to return a portion of the filtrate to the recirculation/dosing tank (figure 4-26). The wastewater is dosed to the filter surface on a timed cycle 1 to 3 times per hour. The returned filtrate mixes with fresh septic tank effluent before being returned to the filter.

Media types

Many types of media are used in packed bed filters. Washed, graded sand is the most common medium. Other granular media used include gravel, anthracite, crushed glass, expanded shale, and bottom ash from coal-fired power plants. Bottom ash has been studied successfully by Swanson and Dix (1987). Crushed glass has been studied (Darby et al., 1996; and Emerick et al., 1997), and it was found to perform similarly to sand of similar size and uniformity. Expanded shale appears to have been successful in some field trials in Maryland, but the data are currently incomplete in relation to long-term durability of the medium.

Foam chips, peat, and nonwoven coarse-fiber synthetic textile materials have also been used. These are generally restricted to proprietary units. Probably the most studied of these is the peat filter, which has become fairly common in recent years. Depending on the type of peat used, the early performance of these systems will produce an effluent with a low pH and a yellowish color. This is accompanied by some excellent removal of organics and microbes, but would generally not be acceptable as a surface discharge (because of low pH and visible color). However, as a pretreatment for a SWIS, low pH and color are not a problem. Peat must meet the same hydraulic requirements as sand (see Fact Sheets 10 and 11). The primary advantage of the proprietary materials, the expanded shale, and to some degree the peat is their light weight, which makes them easy to transport and use at any site. Some short-term studies of nonwoven fabric filters have shown promise (Roy and Dube, 1994). System manufacturers should be contacted for application and design using these materials.

4.7.2 Applications

Sand media filters may be used for a broad range of applications, including single-family residences, large commercial establishments, and small communities. They are frequently used to pretreat wastewater prior to subsurface infiltration on sites where the soil has insufficient unsaturated depth above ground water or bedrock to achieve adequate treatment. They are also used to meet water quality requirements before direct discharge to a surface water. They are used primarily to treat domestic wastewater, but they have been used successfully in treatment trains to treat wastewaters high in organic materials such as those from restaurants and supermarkets. Single pass filters are most frequently used for smaller applications and sites where nitrogen removal is not required. Recirculating filters are used for both large and small flows

Performance of sand and other filters

Twelve innovative treatment technologies were installed to replace failed septic systems in the Narragansett Bay watershed, which is both pathogen- and nitrogen-sensitive. The technologies installed consisted of an at-grade recirculating sand filter, single pass sand filters, Maryland-style recirculating sand filters, foam biofilters, and a recirculating textile filter. The treatment performance of these systems was monitored over an 18-month period. In the field study, TSS and BOD_5 concentrations were typically less than 5 mg/L for all sand filter effluent and less than 20 mg/L for both the foam biofilter and textile filter effluents. Single pass sand filters achieved substantial fecal coliform reductions, reaching mean discharge levels ranging from 200 to 520 colonies per 100 mL for all 31 observations. The at-grade recirculating sand filter achieved the highest total nitrogen reductions of any technology investigated and consistently met the Rhode Island state nitrogen removal standard (a TN reduction of 50 percent or more and a TN concentration of 19 mg/L or less) throughout the study.

Source: Loomis et al., 2001.

and are frequently used where nitrogen removal is necessary. Nitrogen removal of up to 70 to 80 percent can be achieved if an anoxic reactor is used ahead of the recirculation tank, where the nitrified return filtrate can be mixed with the carbon-rich septic tank effluent (Anderson et al., 1998; Boyle et al., 1994; Piluk and Peters, 1994).

4.7.3 Performance

The treatment performance of single-pass and recirculating filters is presented in table 4-16. The medium used was sand or gravel as noted. Recirculating sand filters generally match or outperform single-pass filters in removal of BOD, TSS, and nitrogen. Typical effluent concentrations for domestic wastewater treatment are less than 10 mg/L for both BOD and TSS, and nitrogen removal is approximately 50 percent. Single-pass sand filters can also typically produce an effluent of less than 10 mg/L for both BOD and TSS. Effluent is nearly completely nitrified, but some variability can be expected in nitrogen removal capability. Pell and Nyberg (1989) found typical nitrogen removals of 18 to 33 percent with their intermittent sand filter. Fecal coliform removal is somewhat better in single pass filters. Removals range from 2 to 4 logs in both types of filters. Intermittent sand filter fecal coliform removal is a function of hydraulic loading; removals decrease as the loading rate increases above 1 gpm/ft^2 (Emerick et al., 1997).

Effluent suspended solids from sand filters are typically low. The medium retains the solids. Most of the organic solids are ultimately digested. Gravel filters, on the other hand, do not retain solids as well.

excessive solids buildup due to the lack of periodic sludge pumping and removal. In such cases, the solids storage capacity of the final settling compartment might be exceeded, which results in the discharge of solids into the effluent. ATU performance and effluent quality can also be negatively affected by the excessive use of toxic household chemicals. ATUs must be properly operated and maintained to ensure acceptable performance.

4.8 Aerobic treatment units

Aerobic treatment units (ATUs) refer to a broad category of pre-engineered wastewater treatment devices for residential and commercial use. ATUs are designed to oxidize both organic material and ammonium-nitrogen (to nitrate nitrogen), decrease suspended solids concentrations and reduce pathogen concentrations.

A properly designed treatment train that incorporates an ATU and a disinfection process can provide a level of treatment that is equivalent to that level provided by a conventional municipal biological treatment facility. The AUT, however, must be properly designed, installed, operated and maintained.

Although most ATUs are suspended growth devices, some units are designed to include both suspended growth mechanisms combined with fixed-growth elements. A third category of ATU is designed to provide treatment entirely through the use of fixed-growth elements such as trickling filters or rotating biological contactors (refer to sheets 1 through 3). Typical ATU's are designed using the principles developed for municipal-scale wastewater treatment and scaled down for residential or commercial use.

Most ATUs are designed with compressors or aerators to oxygenate and mix the wastewater. Partial pathogen reduction is achieved. Additional disinfection can be achieved through chlorination, UV treatment, ozonation or soil filtration. Increased nutrient removal (denitrification) can be achieved by modifying the treatment process to provide an anaerobic/anoxic step or by adding treatment processes to the treatment train.

4.8.1 Treatment mechanisms

ATUs may be designed as continuous or batch flow systems (refer to fact sheets 1 through 3). The simplest continuous flow units are designed with no flow equalization and depend upon aeration tank volume and/or baffles to reduce the impact of hydraulic surges. Some units are designed with flow-dampening devices, including air lift or float-controlled mechanical pumps to transfer the wastewater from the aeration tank to a clarifier. Other units are designed with multiple-chambered tanks to attenuate flow. The batch (fill and draw) flow system design eliminates the problem of hydraulic variation. Batch systems are designed to collect and treat wastewater over a period of time.

Table 4-16. Single pass and recirculating filter performance.

Reference	BOD Inf. (mg/L)	BOD Eff. (mg/L)	BOD % Rem	TSS Inf. (mg/L)	TSS Eff. (mg/L)	TSS % Rem	TKN Inf. (mg-N/L)	TKN Eff. (mg-N/L)	TKN % Rem	TN Inf. (mg-N/L)	TN Eff. (mg-N/L)	TN % Rem	Fecal Coliforms Inf. (#/100mL)	Fecal Coliforms Eff. (#/100mL)	Fecal Coliforms % Rem	Comments
Single Pass Filters																
Cagle & Johnson (1994)[a] California	160	2	98.75	73	16	78.08	61.8	5.9	90.45	61.8	37.4	39.48	1.14E+05	1.11E+02	99.90	Sand media: es=0.25-0.65 mm; uc=3-4. Design hydraulic loadings=1.2 gpd/ft² based on 150 gpd/bedroom. Actual flows not measured.
Effert, et al. (1985)[a] Ohio	127	4	96.85	53	17	67.92	--	--	--	41.5	37.5	9.64	2.19E+05	1.60E+03	99.27	Sand media: es=0.4 mm, uc=2.5. Average loadings=0.4 gpd/ft² / 0.42 lb BOD/1000ft Doses per day=3.3.
Ronayne, et al. (1982)[a] Oregon	217	3	98.62	146	10	93.15	57.1	1.7	97.02	57.5	30.3	47.30	2.60E+05	4.07E+02	99.84	Sand media: es=0.14-0.30 mm; uc=1.5-4.0. Average loadings=0.33-0.70 gpd/ft BOD/1000ft²-day.
Sievers (1998)[a] Missouri	297	3	98.99	44	3	93.18	37	0.5	98.65	37.1	27.5	25.88	4.56E+05	7.30E+01	99.98	Sand media: not reported. Design hydraulic loading=1 gpd/ft². Daily flows not reported.
Recirculating Filters																
Louden, et al. (1985)[a] Michigan	150	6	96.00	42	6	85.71	55	2.3	95.82	55	26	52.73	3.40E+03	1.40E+01	99.59	Sand media: es=0.3 mm, uc=4.0. Average loadings=0.9 gpd/ft²(forward flow) / 1.13 lb BOD/1000ft²-day. Recirculation ratio=3:1. Dosed 4-6 times per hour. Open surface, sprinkler
Piluk & Peters (1994)[a] Maryland	235	5	97.87	75	8	89.33	--	--	--	57	20	64.91	1.80E+06	9.20E+03	99.49	Sand media: es=1 mm, uc=<2.5. Design hydraulic loading3.54 gpd/ft²(forward flow). Actual flows not measured. Recirculation ratio=3:1. Doses per day=24.
Ronayne, et al. (1982)[a] Oregon	217	3	98.62	148	4	97.26	57.1	1.1	98.07	57.5	31.5	45.22	2.60E+05	8.50E+03	96.73	Sand media: es=1.2 mm, uc=2.0. Maximum hydraulic loading (forward flow)=3.1 gpd/ft Recirculation ratio=3:1-4:1. Doses/day=48.
Roy & Dube (1994)[a] Quebec	101	6	94.06	77	3	96.10	37.7	7.9	79.05	37.7	20.1	46.68	4.80E+05	1.30E+04	97.29	Gravel media: es=4.0, uc=<2/5. Design hydraulic loading (forward flow)=23.4 gpd/ft ratio=5:1. Doses per day=48. Open surface, winter operation.
Ayres Assoc. (1998a)[b] Wisconsin	601	10	98.34	546	9	98.35	65.9	3	95.45	65.9	16	75.72	>2500	6.20E+01	>98	Gravel media: pea gravel (3/8-in. dia.). Design hydraulic loading=15 gpd/ft² (forward flow). Recirculation ratio=3:1-5:1. Doses per day=72. Open surface, seasonal operation.
Owen & Bobb (1994)[c] Wisconsin	80	8	90.00	36	6	83.33	--	--	>95	--	--	--	--	--	--	Sand media: es=1.5 mm, uc=4-5. Design hydraulic loading=2.74 gpd/ft² (forward flow). Recirculation ratio=1:1 to 4:1. Open surface, winter operation.

[a] Single-family home filters. [b] Restaurant (grease and oil inf/eff = 119/<1 mg/L respectively). [c] Small community treating average 15,000 gpd of septic tank effluent. [d] 1 gpd/ft² = 4 cm/day = 0.04m³/m²xday. [e] 1 lb BOD/1000ft²xday = 0.00455 kg/m²xday

Pumps are used to discharge the settled effluent at the end of the cycle (usually one day). Fixed film treatment plants typically are operated as continuous flow systems.

Oxygen is transferred by diffused air, sparged turbine, or surface entrainment devices. When diffused air systems are used, blowers or compressors are used to force the air through diffusers near the bottom of the tank. The sparged turbine is typically designed with a diffused air source and an external mixer, e.g., a submerged flat-bladed turbine. The sparged turbine is more complex than the simple diffused air system. A variety of surface entrainment devices aerate and mix the wastewater. Air is entrained and circulated in the mixed liquor through violent agitation from mixing or pumping.

The separation of process-generated solids by clarification or filtration is a critical design factor for successful ATU performance. Most ATUs are designed to rely on the process of simple gravity separation to remove most of the solids. Some systems include effluent filters within the clarifier to further screen and retain solids in the treatment plant. Gas deflection barriers and scum baffles are a part of some designs and are a simple way to keep floating solids away from the weir area. Properly managed uplow clarifiers can improve separation.

4.8.2 Design Considerations

ATU's are typically rated by hydraulic capacity and organic and solids loadings. ATU daily treatment volumes may range from 400 gpd to a maximum of 1,500 gpd. ATUs typically can be used to treat residential wastewaters with influent concentrations which have 100 mg/L to 300 mg/L total organic compounds and 100 mg/L to 350 mg/L total suspended solids. Design flows are generally set by local sanitary codes for residential and commercial dwellings using methods described in Section 3.3.

ATU's should be equipped with audio and visual alarms to warn of compressor/aerator failure and high water. These alarms alert the owner and/or service provider of service issues that require immediate attention.

ATU's should be constructed of noncorrosive materials, including reinforced plastics and fiberglass, coated steel, and reinforced concrete. Buried ATU's must be designed to provide easy access to mechanical parts, electrical control systems, and appurtenances requiring maintenance such as weirs, air lift pump lines, etc. ATU's installed above ground should be properly housed to protect against severe climatic conditions. Installation should be in accordance with manufacturers' specifications.

Appurtenances should be constructed of corrosion-free materials including polyethylene plastics. Air diffusers are usually constructed of PVC or ceramic stone. Mechanical components must be either waterproofed and/or protected from the elements. Because blowers, pumps, and other prime movers can be subject to harsh environments and continuous operation, they should be designed for heavy duty use. Proper housing can reduce blower noise.

4.8.3 Applications

ATUs are typically integrated in a treatment train to provide additional treatment before the effluent is discharged to a SWIS. ATU-treatment trains can also be designed to discharge to land and surface waters; ATU discharge is suitable for drip irrigation if high quality effluent is consistently maintained through proper management. Although some jurisdictions allow reductions in vertical separation distances and/or higher soil infiltration rates when ATUs are used, consideration must be given to the potential impacts of higher hydraulic and pollutant loadings. Increased flow through the soil may allow deeper penetration of pathogens and decreased treatment efficiency of other pollutants (see sections 4.4.2 and 4.4.5).

4.8.4 Performance

Managed ATU effluent quality is typically characterized as 25 mg/L or less CBOD5 and 30 mg/L or less TSS. Fecal coliform counts are typically 3-4 log # / 100 ml (Table 3-19) when the ATUs are operated at or below their design flows and the influent is typical domestic sewage. Effluent nutrient levels are dependent on influent concentrations, climate, and operating conditions.

Other wastewater characteristics may influence performance. Cleaning agents, bleach, caustic agents, floating matter, and other detritus can plug or damage equipment. Temperature will affect process efficiency, i.e., treatment efficiency generally will improve as the temperature increases.

Owners should be required by local sanitary codes or management program requirements to maintain ongoing service agreements for the life of the system. ATU's should be inspected every three months to help ensure proper operation and treatment effectiveness. Many ATU manufacturers offer a two-year warranty with an optional service agreement after the warranty expires. Inspections generally include visual checks of hoses, wires, leads and contacts, testing of alarms, examination of the mixed liquor, cleaning of filters, removal of detritus, and inspection of the effluent. ATU's should be pumped when the mixed-liquor (aerator) solids are above 6,000 mg/L or the final settler is more than 1/3 full of settled solids.

4.8.5 Risk management

ATU's should be designed to protect the treatment capability of the soil dispersal system and also to sound alarms or send signals to the management entity (owners and/or service providers) when inspection or maintenance is needed. All biological systems are sensitive to temperature, power interruptions, influent variability, and shock loadings of toxic chemicals. Successful operation of ATUs depends on adherence to manufacturers' design and installation requirements and good management that employs meaningful measurements of system performance at sufficiently frequent intervals to ascertain changes in system function. Consistent performance depends on a stable power supply, an intact system as designed, and routine maintenance to ensure that components and appurtenances are in good order. ATU's, like all other onsite wastewater treatment technologies, will fail if they are not designed, installed, or operated properly. Vigilance on the part of owners and service providers is essential to ensure ATUs are operated and maintained to function as designed.

4.8.6 Costs

Installed ATU costs range from $2500 to $9000 installed. Pumping may be necessary at any time due to process upsets, or every eight to twelve months, depending on influent quality, temperature and type of process. Pumping could cost from $100-to-$300, depending on local requirements. Aerators/compressors last about three to five years and cost from $300 to $500 to replace.

Many communities require service contracts. These contracts typically range in cost between $100 and $400 per year, depending on the options and features the owners choose. The high end includes pumping costs. Power requirements are generally quoted at around $200/year.

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APPENDIX K

PRIVATE SEWAGE DISPOSAL SYSTEMS

K1 Private Sewage Disposal – General

(a) Where permitted by Section 713.0, the building sewer may be connected to a private sewage disposal system complying with the provisions of this appendix. The type of system shall be determined on the basis of location, soil porosity, and ground water level and shall be designed to receive all sewage from the property. The system, except as otherwise approved, shall consist of a septic tank with effluent discharging into a subsurface disposal field, into one (1) or more seepage pits or into a combination of subsurface disposal field and seepage pits. The Administrative Authority may grant exceptions to the provisions of this appendix for permitted structures which have been destroyed due to fire or natural disaster, and which cannot be reconstructed in compliance with these provisions.

(b) Where the quantity or quality of the sewage is such that the above system cannot be expected to function satisfactorily; for commercial, agricultural, and industrial plumbing systems; for installations where appreciable amounts of industrial or indigestible wastes are produced; for occupancies producing abnormal quantities of sewage or liquid waste; or when grease interceptors are required by other parts of this Code, the method of sewage treatment and disposal shall be first approved by the Administrative Authority. Special sewage disposal systems for minor, limited, or temporary uses shall be first approved by the Administrative Authority.

(c) Disposal systems shall be designed to utilize the most porous or absorptive portions of the soil formation. Where the ground water level extends to within twelve (12) feet (3658 mm) or less of the ground surface or where the upper soil is porous and the underlying stratum is rock or impervious soil, a septic tank and disposal field system shall be installed.

(d) All private sewage disposal systems shall be so designed that additional seepage pits or subsurface drain fields, equivalent to at least one hundred (100) percent of the required original system, may be installed if the original system cannot absorb all the sewage. No division of the lot or erection of structures on the lot shall be made if such division or structure impairs the usefulness of the one hundred (100) percent expansion area.

(e) No property shall be improved in excess of its capacity to properly absorb sewage effluent by the means provided in this Code.

Exception: The Administrative Authority may, at his discretion, approve an alternate system.

(f) No private sewage disposal system, or part thereof, shall be located in any lot other than the lot which is the site of the building or structure served by such private sewage disposal system; nor shall any private sewage disposal system or part thereof be located at any point having less than the minimum distances indicated in Table K-1.

Nothing contained in this Code shall be construed to prohibit the use of all or part of an abutting lot to provide additional space for a private sewage disposal system or part thereof, when proper cause, transfer of ownership, or change of boundary not in violation of other requirements has been first established to the satisfaction of the Administrative Authority. The instrument recording such action shall constitute an agreement with the Administrative Authority which shall clearly state and show that the areas so joined or used shall be maintained as a unit during the time they are so used. Such agreement shall be recorded in the office of the County Recorder as part of the conditions of ownership of said properties, and shall be binding on all heirs, successors, and assigns to such properties. A copy of the instrument recording such proceedings shall be filed with the Administrative Authority.

(g) When there is insufficient lot area or improper soil conditions for adequate sewage disposal for the building or land use proposed, and Administrative Authority so finds, no building permit shall be issued and no private sewage disposal shall be permitted. Where space or soil conditions are critical, no building permit shall be issued until engineering data and test reports satisfactory to the Administrative Authority have been submitted and approved.

(h) Nothing contained in this appendix shall be construed to prevent the Administrative Authority from requiring compliance with higher requirements than those contained herein, where such higher requirements are essential to maintain a safe and sanitary condition.

(i) Alternate systems may be used only by special permission of the Administrative Authority after being satisfied of their adequacy. This authorization may be based on extensive field and test data from conditions similar to those at the proposed site or may require such additional data as may be necessary to provide assurance that the alternate system will produce continuous and long-range results at the proposed site, at least equivalent to systems which are specifically authorized.

If demonstration systems are to be considered for installation, conditions for installation, maintenance, and monitoring at each such site shall first be established by the Administrative Authority.

Aerobic Systems. Approved aerobic systems may be substituted for conventional septic tanks provided the Administrative Authority is satisfied that such systems will produce results at least equivalent to septic tanks, whether their aeration systems are operating or not.

K 2 Capacity of Septic Tanks

The liquid capacity of all septic tanks shall conform to Tables K-2 and K-3 as determined by the number of bedrooms or apartment units in dwelling occupancies and the estimated waste/sewage design flow rate or the number of plumbing fixture units as determined from Table 7-3, whichever is greater in other building occupancies. The capacity of any one septic tank and its drainage system shall be limited by the soil structure classification, as specified in Table K-5.

K 3 Area of Disposal Fields and Seepage Pits

The minimum effective absorption area in disposal fields in square feet (m^2), and in seepage pits in square feet (m^2) of side wall, shall be predicated on the required septic tank capacity in gallons (liters) and/or estimated waste/sewage flow rate, whichever is greater, and shall conform to Table K-4 as determined for the type of soil found in the excavation, and shall be as follows:

(1) When disposal fields are installed, a minimum of one hundred and fifty (150) square feet (14 m^2) of trench bottom shall be provided for each system exclusive of any hard pan, rock, clay, or other impervious formations. Side wall area in excess of the required twelve (12) inches (305 mm) and not to exceed thirty-six (36) inches (914 mm) below the leach line may be added to the trench bottom area when computing absorption areas.

(2) Where leaching beds are permitted in lieu of trenches, the area of each such bed shall be at least fifty (50) percent greater than the tabular requirements for trenches. Perimeter side wall area in excess of the required twelve (12) inches (305 mm) and not to exceed thirty-six (36) inches (914 mm) below the leach line may be added to the trench bottom area when computing absorption areas.

(3) No excavation for a leach line or leach bed shall extend within five (5) feet (1524 mm) of the water table nor to a depth where sewage may contaminate the underground water stratum that is usable for domestic purposes.

> **Exception:** In areas where the records or data indicate that the ground waters are grossly degraded, the five (5) foot (1524 mm) separation requirement may be reduced by the Administrative Authority. The applicant shall supply evidence of ground water depth to the satisfaction of the Administrative Authority.

(4) The minimum effective absorption area in any seepage pit shall be calculated as the excavated side wall area below the inlet exclusive of any hardpan, rock, clay, or other impervious formations.

The minimum required area of porous formation shall be provided in one or more seepage pits. No excavation shall extend within ten (10) feet (3048 mm) of the water table nor to a depth where sewage may contaminate underground water stratum that is usable for domestic purposes.

> **Exception:** In areas where the records or data indicate that the ground waters are grossly degraded, the ten (10) foot (3048 mm) separation requirement may be reduced by the Administrative Authority.
>
> The applicant shall supply evidence of ground water depth to the satisfaction of the Administrative Authority.

(5) Leaching chambers shall be sized on the bottom absorption area (nominal unit width) in square feet. The required area shall be calculated using Table K-4 with a 0.70 multiplier.

K 4 Percolation Test

(a) Wherever practicable, disposal field and seepage pit sizes shall be computed from Table K-4. Seepage pit sizes shall be computed by percolation tests unless use of Table K-4 is approved by the Administrative Authority.

(b) In order to determine the absorption qualities of seepage pits and of questionable soils other than those listed in Table K-4, the proposed site shall be subjected to percolation tests acceptable to the Administrative Authority.

(c) When a percolation test is required, no private disposal system shall be permitted to serve a building if that test shows the absorption capacity of the soil is less than 0.83 gallons per square foot (33.8 L/m^2) or more than 5.12 gallons per square foot (208 L/m^2) of leaching area per 24 hours. If the percolation test shows an absorption rate greater than 5.12 gallons per square foot (208 L/m^2) per 24 hours, a private disposal system may be permitted if the site does not overlie ground waters protected for drinking water supplies, a minimum thickness of two (2) feet (610 mm) of the native soil below the entire proposed system is replaced by loamy sand, and the system design is based on percolation tests made in the loamy sand.

K 5 Septic Tank Construction

(a) Plans for all septic tanks shall be submitted to the Administrative Authority for approval. Such plans shall show all dimensions, reinforcing, structural calculations, and such other pertinent data as may be required.

(b) Septic tanks design shall be such as to produce a clarified effluent consistent with accepted standards and shall provide adequate space for sludge and scum accumulations.

(c) Septic tanks shall be constructed of solid durable materials, not subject to excessive corrosion or decay and shall be watertight.

(d) Septic tanks shall have a minimum of two (2) compartments. The inlet compartment of any septic tank shall be not less than two-thirds (2/3) of the total capacity of the tank, nor less than five hundred (500) gallons (2.0 m^3) liquid capacity, and shall be at least three (3) feet (914 mm) in width and five (5) feet (1524 m m) in length. Liquid depth shall be not less than two (2) feet (610 mm) and six (6) inches (152 mm) nor more than six (6) feet (1829 mm). The secondary compartment of any septic tank shall have a minimum capacity of two hundred fifty (250) gallons (1.0 m^3) and a maximum capacity of one-third (1/3) of the total capacity of such tank. In septic tanks having over fifteen hundred (1500) gallons (6.0 m^3) capacity, the secondary compartment may be not less than five (5) feet (1524) in length.

(e) Access to each septic tank shall be provided by at least two (2) manholes twenty (20) inches (508 mm) in minimum dimension or by an equivalent removable cover slab. One access manhole shall be located over the inlet and one (1) access manhole shall be located over the outlet. Wherever a first compartment exceeds twelve (12) feet (3658 mm) in length, an additional manhole shall be provided over the baffle wall.

(f) The inlet and outlet pipe openings shall be not less in size than the connecting sewer pipe. The vertical leg of a round inlet and outlet fittings shall not be less in size than the connecting sewer pipe nor less than four (4) inches (102 mm). A baffle type fitting shall have the equivalent cross-sectional area of the connecting sewer pipe and not less than a four (4) inch (100 mm) horizontal dimension when measured at the inlet and outlet pipe inverts.

(g) The inlet and outlet pipe or baffle shall extend four (4) inches (100 mm) above and at least twelve (12) inches (305 mm) below the water surface. The invert of the inlet pipe shall be at a level not less than two (2) inches (51 mm) above the invert of the outlet pipe.

(h) Inlet and outlet pipe fittings or baffles, and compartment partitions shall have a free vent area equal to the required cross-sectional area of the house sewer or private sewer discharging therein to provide free ventilation above the water surface from the disposal field or seepage pit through the septic tank, house sewer, and stack to the outer air.

(i) The side walls shall extend at least nine (9) inches (229 mm) above the liquid depth. The cover of the septic tank shall be at least two (2) inches (51 mm) above the back vent openings.

(j) Partitions or baffles between compartments shall be of solid durable material and shall extend at least four (4) inches (102 mm) above the liquid level. An inverted fitting equivalent in size to the tank inlet, but in no case less than four (4) inches (102 mm) in size, shall be installed in the inlet compartment side of the baffle with the bottom of the fitting placed midway in the depth of the liquid. Wooden baffles are prohibited.

(k) Each such tank shall be structurally designed to withstand all anticipated earth or other loads. All septic tank covers shall be capable of supporting an earth load of not less than three hundred (300) pounds per square foot (14.4 kPa) when the maximum coverage does not exceed three (3) feet (914 m m).

(l) Septic tanks installed under concrete or black top paving shall have the required manholes accessible by extending the manhole openings to grade in a manner acceptable to the Administrative Authority.

(m) **Materials**

(1) **Concrete Septic Tanks**

All materials used in constructing a septic tank shall be in accordance with applicable standards in Chapter 14, Table 14-1.

(2) **Steel Septic Tanks**

The minimum wall thickness of any steel septic tank shall be No. 12 U.S. gauge (0.109) (2.8 mm) and each such tank shall be protected from corrosion, both externally and internally, by an approved bituminous coating or by other acceptable means.

(3) **Alternate Materials**

(i) Septic tanks constructed of alternate materials may be approved by the Administrative Authority when complying with approved applicable standards.

(ii) Wooden septic tanks are prohibited.

(n) **Prefabricated Septic Tanks**

(1) Manufactured or prefabricated septic tanks shall comply with all approved applicable standards and be approved by the Administrative Authority.

(2) independent laboratory tests and engineering calculations certifying the tank capacity and structural stability shall be provided as required by the Administrative Authority.

K 6 Disposal Fields

(a) Distribution lines shall be constructed of clay tile laid with open joints, perforated clay pipe, perforated bituminous fiber pipe, perforated high density polyethylene pipe, perforated ABS pipe, perforated PVC pipe, or other approved materials, provided that sufficient openings are available for distribution of the effluent into the trench area.

(b) Before placing filter material or drain lines in a prepared excavation, all smeared or compacted surfaces shall be removed from trenches by raking to a depth of one (1) inch (25.4 mm) and the loose material removed. Clean stone, gravel, slag, or similar filter material acceptable to the Administrative Authority, varying in size from three fourths (3/4) inch to two and one-half (2-1/2) inches (19.1 mm to 64 mm) shall be placed in the trench to the depth and grade required by this section. Drain pipe shall be placed on filter material in an approved manner. The drain lines shall then be covered with filter material to the minimum depth required by this section and this covered with untreated building paper, straw, or similar porous material to prevent closure of voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspection and acceptance.

Exception: Listed or approved plastic leaching chambers may be used in lieu of pipe and filter material. Chamber installations shall follow the rules for disposal fields, where applicable, and shall conform to manufacturer's installation instructions.

(c) A grade board staked in the trench to the depth of filter material shall be utilized when distribution line is constructed with drain tile or a flexible pipe material which will not maintain alignment without continuous support.

(d) When seepage pits are used in combination with disposal fields, the filter material in the trenches shall terminate at least five (5) feet (1524 mm) from the pit excavation and the line extending from such points to the seepage pit shall be approved pipe with watertight joints.

(e) Where two (2) or more drain lines are installed, an approved distribution box of sufficient size to receive lateral lines shall be installed at the head of each disposal field. The inverts of all outlets shall be level and the invert of the inlet shall be at least one (1) inch (25.4 mm) above the outlets. Distribution boxes shall be designed to insure equal flow and shall be installed on a level concrete slab in natural or compacted soil.

Distribution boxes shall be coated on the inside with a bituminous coating or other approved method acceptable to the Administrative Authority.

(f) All laterals from a distribution box to the disposal field shall be approved pipe with watertight joints. Multiple disposal field laterals, wherever practicable, shall be of uniform length.

(g) Connections between a septic tank and a distribution box shall be laid with approved pipe with watertight joints on natural ground or compacted fill.

(h) When the quantity of sewage exceeds the amount that can be disposed in five hundred (500) lineal feet (152.4 m) of leach line, a dosing tank shall be used. Dosing tanks shall be equipped with an automatic siphon or pump which discharges the tank once every three (3) or four (4) hours. The tank shall have a capacity equal to sixty (60) to seventy-five (75) percent of the interior capacity of the pipe to be dosed at one time. Where the total length of pipe exceeds one thousand (1000) lineal feet (304.8 m), the dosing tank shall be provided with two (2) siphons or pumps dosing alternately and each serving one-half (1/2) of the leach field.

(i) Disposal fields shall be constructed as follows:

(see chart on the following page)

	Minimum	Maximum
Number of drain lines per field	1	–
Length of each line	–	100 ft. (30480 mm)
Bottom width of trench	18 in. (457 mm)	36 in. (914 mm)
Spacing of lines, center-to-center	6 ft. (1829 mm)	–
Depth of earth cover of lines [preferred –18 in (457 mm)]	12 in. (305 mm)	–
Grade of lines	level	3 in./100 ft. (25 mm/m)
Filter material under drain lines	12 in. (305 mm)	–
Filter material over drain lines	2 in. (51 mm)	–

Minimum spacing between trenches or leaching beds shall be four (4) feet (1219 mm) plus two (2) feet (610 mm) for each additional foot (305 mm) of depth in excess of one (1) foot (305 mm) below the bottom of the drain line. Distribution drain lines in leaching beds shall not be more than six (6) feet (1829 mm) apart on centers and no part of the perimeter of the leaching bed shall be more than three (3) feet (914 m m) from a distribution drain line. Disposal fields, trenches and leaching beds shall not be paved over or covered by concrete or any material that can reduce or inhibit any possible evaporation of sewer effluent.

(j) When necessary on sloping ground to prevent excessive line slope, leach lines or leach beds shall be stepped. The lines between each horizontal section shall be made with watertight joints and shall be designed so each horizontal leaching trench or bed shall be utilized to the maximum capacity before the effluent shall pass to the next lower leach line or bed. The lines between each horizontal leaching section shall be made with approved watertight joints and installed on natural or unfilled ground.

K 7 Seepage Pits

(a) The capacity of seepage pits shall be based on the quantity of liquid waste discharging thereinto, and on the character and porosity of the surrounding soil and shall conform to Section K-3 of this appendix.

(b) Multiple seepage pit installations shall be served through an approved distribution box or be connected in series by means of a water tight connection laid on undistributed or compacted soil, the outlet from the pit shall have an approved vented leg fitting extending at least twelve (12) inches (305 mm) below the inlet fitting.

(c) Each seepage pit shall be circular in shape and shall have an excavated diameter of not less than four (4) feet (1219 mm). Each such pit shall be lined with approved type whole new hard burned clay brick, concrete brick, concrete circular type cesspool blocks, or other approved materials. Approval shall be obtained prior to construction for any pit having an excavated diameter greater than six (6) feet (1829 mm).

(d) The lining in every seepage pit shall be laid on a firm foundation. Lining materials shall be placed tight together and laid with joints staggered. Except in the case of approved type pre-cast concrete circular sections, no brick or block shall be greater in height than its width and shall be laid flat to form at least a four (4) inch (102 mm) wall. Brick or block greater than twelve (12) inches 305 mm) in length shall have chamfered matching ends and be scored to provide for seepage. Excavation voids behind the brick, block, or concrete liner shall have a minimum of six (6) inches (152 mm) of clean three-fourths (3/4) inch (19.1 mm) gravel or rock.

(e) All brick or block used in seepage pit construction shall have a minimum compressive strength of twenty-five hundred (2500) pounds per square inch (17,225 kPa).

(f) Each seepage pit shall have a minimum sidewall (not including the arch) of ten (10) feet (3048 mm) below the inlet.

(g) The arch or dome of any seepage pit may be constructed in one of three ways:

(1) Approved type hard burned clay brick, or solid concrete brick, or block laid in cement mortar.

(2) Approved brick or block laid dry.

In both of the above methods, an approved cement mortar covering of at least two (2) inches (51 mm) in thickness shall be applied, said covering to extend at least six (6) inches (152 mm) beyond the sidewalls of the pit.

(3) Approved type one or two piece reinforced concrete slab of twenty-five hundred (2500) pounds per square inch (17238 kPa) minimum compressive strength, not less than five (5) inches (127 mm) thick and designed to support an earth load of not less than four hundred (400) pounds

per square foot (19.2 kPa). Each such cover shall be provided with a nine (9) inch (229 mm) minimum inspection hole with plug or cover and shall be coated on the underside with an approved bituminous or other nonpermeable protective compound.

(h) The top of the arch or cover must be at least eighteen (18) inches (457 mm) but not more than four (4) feet (1219 mm) below the surface of the ground.

(i) An approved vented inlet fitting shall be provided in every seepage pit so arranged as to prevent the inflow from damaging the sidewall.

Exception: When using a one or two piece concrete slab cover inlet, fitting may be a one-fourth (1/4) bend fitting discharging through an opening in the top of the slab cover. On multiple seepage pit installations, the outlet fittings shall be per Section K 7(b) of this appendix.

K 8 Cesspools

(a) A cesspool shall be considered only as a temporary expedient pending the construction of a public sewer, as an overflow facility when installed in conjunction with an existing cesspool, or as a means of sewage disposal for limited, minor, or temporary uses when first approved by the Administrative Authority.

(b) Where it is established that a public sewer system will be available in less than two (2) years and soil and ground water conditions are favorable to cesspool disposal, cesspools without septic tanks may be installed for single family dwellings or for other limited uses when first approved by the Administrative Authority.

(c) Each cesspool, when permitted, shall conform to the construction requirements set forth in Section K 7 of this appendix for seepage pits and shall have a minimum sidewall (not including arch) of twenty (20) feet (6096 mm) below the inlet provided, however, that when a strata of gravel or equally pervious material of four (4) feet (1219 mm) in thickness is found, the depth of such sidewall need not be more than ten (10) feet (3048 mm) below the inlet.

(d) When overflow cesspools or seepage pits are added to existing installations, the effluent shall leave the existing pit through an approved vented leg extending at least twelve (12) inches (305 mm) downward into such existing pit and having its outlet flow line at least six (6) inches (152 mm) below the inlet. All pipe between pits shall be laid with approved watertight joints.

K 9 Commercial or Industrial Special Liquid Waste Disposal

(a) When liquid wastes containing excessive amounts of grease, garbage, flammable wastes, sand, or other ingredients which may affect the operation of a private sewage disposal system, an interceptor for such wastes shall be installed.

(b) Installation of such interceptors shall comply with Section 1009.0 of the Uniform Plumbing Code and their location shall be in accordance with Table K-1 of this appendix.

(c) Sampling box shall be installed when required by the Administrative Authority.

(d) Interceptors shall be of approved design and be of not less than two (2) compartments. Structural requirements shall be in compliance with the applicable subparts of Section K 5 of this appendix.

(e) Interceptors shall be located as close to the source as possible and be accessible for servicing. All necessary manholes for servicing shall be at grade level and be gastight.

(f) Waste discharge from interceptors may be connected to a septic tank or other primary system or be disposed into a separate disposal system.

(g) **Recommended Design Criteria.** (Formulae may be adapted to other types of occupancies with similar wastes.) *See charts on the following page.*

K 10 Inspection and Testing

(a) **Inspection**

(1) Applicable provision of Section 103.5 of the Uniform Plumbing Code and this appendix shall be complied with. Plans may be required per Section 101.3 of this Code.

(2) System components shall be properly identified as to manufacturer. Septic tanks or other primary systems shall have the rated capacity permanently marked on the unit.

(3) Septic tanks or other primary systems shall be installed on dry, level, well-compacted soil.

(4) If design is predicated on soil tests, the system shall be installed at the same location and depth as the tested area.

(b) **Testing**

(1) Septic tanks or other primary components shall be filled with water to flow line prior to requesting inspection. All seams or joints shall be left exposed (except the bottom) and the tank shall remain watertight.

(2) A flow test shall be performed through the system to the point of effluent disposal. All lines and components shall be watertight. Capacities,

Grease and Garbage, Commercial Kitchens

Number of meals per peak hour	x	Waste flow rate	x	Retention time	x	Storage factor	=	Interceptor size (liquid capacity)

Sand-Silt Oil, Auto Washers

Number of vehicles per hour	x	Waste flow rate	x	Retention time	x	Storage factor	=	Interceptor size (liquid capacity)

Silt-Lint Grease, Laundries, Laundromats

Number of machines	x	2 cycles per hour	x	Waste flow rate	x	Retention time	x	Storage Factor	=	Interceptor size (liquid capacity)

Waste Flow Rate
See Table K-3 of this appendix for estimated flow rates.

Retention Times

Commercial kitchen waste:
Dishwasher and/or disposal....................2.5 hours
Single service kitchen:
Single serving with disposal....................1.5 hours
Sand-silt-oil....................2.0 hours
Lint-silt (laundry)....................2.0 hours

Storage Factors

Fully equipped commercial kitchen....................8 hr. operation: 1
16 hr. operation: 2
24 hr. operation: 3
Single service kitchen....................1.5
Auto washers....................self-serve: 1.5
employee operated: 2
Laundries, laundromats....................1.5 (allows for rock filter)

required air space, and fittings shall be in accordance with the provisions set forth in this appendix.

K 11 Abandoned Sewers and Sewage Disposal Facilities

(a) Every abandoned building (house) sewer, or part thereof, shall be plugged or capped in an approved manner within five (5) feet (1524 mm) of the property line.

(b) Every cesspool, septic tank, and seepage pit which has been abandoned or has been discontinued otherwise from further use or to which no waste or soil pipe from a plumbing fixture is connected, shall have the sewage removed therefrom and be completely filled with the earth, sand, gravel, concrete, or other approved material.

(c) The top cover or arch over the cesspool, septic tank, or seepage pit shall be removed before filling and the filling shall not extend above the top of the vertical portions of the sidewalls or above the level of any outlet pipe until inspection has been called and the cesspool, septic tank, or seepage pit has been inspected. After such inspection, the cesspool, septic tank, or seepage pit shall be filled to the level of the top of the ground.

(d) No person owning or controlling any cesspool, septic tank, or seepage pit on the premises of such person or in that portion of any public street, alley, or other public property abutting such premises, shall fail, refuse, or neglect to comply with the provisions of this section or upon receipt of notice so to comply from the Department having jurisdiction.

(e) Where disposal facilities are abandoned consequent to connecting any premises with the public sewer, the permittee making the connection shall fill all abandoned facilities as required by the Administrative Authority within thirty (30) days from the time of connecting to the public sewer.

K 12 Drawings and Specifications

The Administrative Authority, Health Officer, or other Department having jurisdiction may require any or all of the following information before a permit is issued for a private sewage disposal system, or at any time during the construction thereof.

(a) Plot plan drawn to scale completely dimensioned, showing direction and approximate slope of surface, location of all present or proposed retaining walls, drainage channels, water supply lines or wells, paved areas and structures on the plot, number of bedrooms or plumbing fixtures in each structure and location of the private sewage disposal system with relation to lot lines and structures.

(b) Details of construction necessary to assure compliance with the requirements of this appendix together with a full description of the complete installation including quality, kind and grade of all materials, equipment, construction, workmanship, and methods of assembly and installation.

(c) A log of soil formations and ground water level as determined by test holes dug in close proximity to any proposed seepage pit or disposal field, together with a statement of water absorption characteristics of the soil at proposed site as determined by approved percolation tests.

TABLE K-1

Location of Sewage Disposal System

Minimum Horizontal Distance In Clear Required From:	Building Sewer	Septic Tank	Disposal Field	Seepage Pit or Cesspool
Buildings or structures[1]	2 feet (610 m m)	5 feet (1524 mm)	8 feet (2438 mm)	8 feet (2438 mm)
Property line adjoining private property	Clear[2]	5 feet (1524 mm)	5 feet (1524 mm)	8 feet (2438 mm)
Water supply wells	50 feet[3] (15240 mm)	50 feet (15240 mm)	100 feet (30.5 m)	150 feet (45.7 m)
Streams	50 feet (15240 mm)	50 feet (15240 mm)	50 feet[7] (15240 mm)[7]	100 feet[7] (30.5 m)[7]
Trees	–	10 feet (3048 mm)	–	10 feet (3048 mm)
Seepage pits or cesspools	–	5 feet (1524 mm)	5 feet (1524 mm)	12 feet (3658 mm)
Disposal field	–	5 feet (1524 mm)	4 feet[4] (1219 mm)	5 feet (1524 mm)
On site domestic water service line	1 foot[5] (305 mm)	5 feet (1524 mm)	5 feet (1524 mm)	5 feet (1524 mm)
Distribution box	–	–	5 feet (1524 mm)	5 feet (1524 mm)
Pressure public water main	10 feet[6] (3048 mm)	10 feet (3048 mm)	10 feet (3048 mm)	10 feet (3048 mm)

Note:
When disposal fields and/or seepage pits are installed in sloping ground, the minimum horizontal distance between any part of the leaching system and ground surface shall be fifteen (15) feet (4572 mm).

1. Including porches and steps, whether covered or uncovered, breezeways, roofed porte-cocheres, roofed patios, carports, covered walks, covered driveways and similar structures or appurtenances.
2. See also Section 313.3 of the Uniform Plumbing Code.
3. All drainage piping shall clear domestic water supply wells by at least fifty (50) feet (15240 mm). This distance may be reduced to not less than twenty-five (25) feet (7620 mm) when the drainage piping is constructed of materials approved for use within a building.
4. Plus two (2) feet (610 mm) for each additional (1)foot (305 mm) of depth in excess of one (1) foot (305 mm) below the bottom of the drain line. (See also Section K 6.)
5. See Section 720.0 of the Uniform Plumbing Code.
6. For parallel construction – For crossings, approval by the Health Department shall be required.
7. These minimum clear horizontal distances shall also apply between disposal field, seepage pits, and the ocean mean higher high tide line.

TABLE K-2
Capacity of Septic Tanks*

Single Family Dwellings – Number of Bedrooms	Multiple Dwelling Units or Apartments – One Bedroom Each	Other Uses: Maximum Fixture Units Served per Table 7-3	Minimum Septic Tank Capacity in Gallons	(liters)
1 or 2		15	750	(2838)
3		20	1000	(3785)
4	2 units	25	1200	(4542)
5 or 6	3	33	1500	(5678)
	4	45	2000	(7570)
	5	55	2250	(8516)
	6	60	2500	(9463)
	7	70	2750	(10,409)
	8	80	3000	(11,355)
	9	90	3250	(12,301)
	10	100	3500	(13,248)

Extra bedroom, 150 gallons (568 liters) each.
Extra dwelling units over 10, 250 gallons (946 liters) each.
Extra fixture units over 100, 25 gallons (95 liters) per fixture unit.

*Note: Septic tank sizes in this table include sludge storage capacity and the connection of domestic food waste disposal units without further volume increase.

TABLE K-3
Estimated Waste/Sewage Flow Rates

Because of the many variables encountered, it is not possible to set absolute values for waste/sewage flow rates for all situations. The designer should evaluate each situation and, if figures in this table need modification, they should be made with the concurrence of the Administrative Authority.

Type of Occupancy	Gallons (liters) Per Day
1. Airports	15 (56.8) per employee 5 (18.9) per passenger
2. Auto washers	Check with equipment manufacturer
3. Bowling alleys (snack bar only)	75 (283.9) per lane
4. Camps:	
Campground with central comfort station	35 (132.5) per person
Campground with flush toilets, no showers	25 (94.6) per person
Day camps (no meals served)	15 (56.8) per person
Summer and seasonal	50 (189.3) per person
5. Churches (Sanctuary)	5 (18.9) per seat
with kitchen waste	7 (26.5) per seat
6. Dance halls	5 (18.9) per person
7. Factories	
No showers	25 (94.6) per employee
With showers	35 (132.5) per employee
Cafeteria, add	5 (18.9) per employee
8. Hospitals	250 (946.3) per bed
Kitchen waste only	25 (94.6) per bed
Laundry waste only	40 (151.4) per bed
9. Hotels (no kitchen waste)	60 (227.1) per bed (2 person)

TABLE K-3 (Continued)

Type of Occupancy	Gallons (liters) Per Day
10. Institutions (Resident)	75 (283.9) per person
Nursing home	125 (473.1) per person
Rest home	125 (473.1) per person
11. Laundries, self-service (minimum 10 hours per day)	50 (189.3) per wash cycle
Commercial	Per manufacturer's specifications
12. Motel	50 (189.3) per bed space
with kitchen	60 (227.1) per bed space
13. Offices	20 (75.7) per employee
14. Parks, mobile homes	250 (946.3) per space
picnic parks (toilets only)	20 (75.7) per parking space
recreational vehicles –	
without water hook-up	75 (283.9) per space
with water and sewer hook-up	100 (378.5) per space
15. Restaurants – cafeterias	20 (75.7) per employee
toilet	7 (26.5) per customer
kitchen waste	6 (22.7) per meal
add for garbage disposal	1 (3.8) per meal
add for cocktail lounge	2 (7.6) per customer
kitchen waste –	
disposable service	2 (7.6) per meal
16. Schools – Staff and office	20 (75.7) per person
Elementary students	15 (56.8) per person
Intermediate and high	20 (75.7) per student
with gym and showers, add	5 (18.9) per student
with cafeteria, add	3 (11.4) per student
Boarding, total waste	100 (378.5) per person
17. Service station, toilets	1000 (3785) for 1st bay 500 (1892.5) for each additional bay
18. Stores	20 (75.7) per employee
public restrooms, add	1 per 10 sq. ft. (4.1/m^2) of floor space
19. Swimming pools, public	10 (37.9) per person
20. Theaters, auditoriums	5 (18.9) per seat
drive-in	10 (37.9) per space

(a) **Recommended Design Criteria.** Sewage disposal systems sized using the estimated waste/sewage flow rates should be calculated as follows:

(1) Waste/sewage flow, up to 1500 gallons/day (5677.5 L/day)
Flow x 1.5 = septic tank size

(2) Waste/sewage flow, over 1500 gallons/day (5677.5 L/day)
Flow x 0.75 + 1125 = septic tank size

(3) Secondary system shall be sized for total flow per 24 hours.

(b) Also see Section K 2 of this appendix.

TABLE K-4
Design Criteria of Five Typical Soils

Type of Soil	Required sq. ft. of leaching area/ 100 gals.	(m^2/L)	Maximum absorption capacity in gals./sq. ft. of leaching area for a 24 hr. period	(L/m^2)
Coarse sand or gravel	20	(0.005)	5.0	(203.7)
Fine sand	25	(0.006)	4.0	(162.9)
Sandy loam or sandy clay	40	(0.010)	2.5	(101.8)
Clay with considerable sand or gravel	90	(0.022)	1.1	(44.8)
Clay with small amount of sand or gravel	120	(0.030)	0.8	(32.6)

TABLE K-5

Required Square Feet of Leaching Area/100 gals Septic Tank Capacity	(m^2/L)	Maximum Septic Tank Size Allowable Gallons	(liters)
20–25	(0.005–0.006)	7500	(28,387.5)
40	(0.010)	5000	(18,925.0)
90	(0.022)	3500	(13,247.5)
120	(0.030)	3000	(11,355.0)

SIZING COMPARISON BETWEEN EXISTING AND PROPOSED REGULATIONS

Given:

- 3 bedroom home
- Soil Type: Ib Med. Sand, Loamy Sand; application rate of 2 sf/gpd
- Aggregate Trench: 2 ft h x 2 ft w

Aggregate Sizing per Existing Regulations:

- Design Flow: 375 gpd
- Required square footage: (375 gpd)x(2 sf/gpd) = 750 sf
- Stone trench, 2 ft wide, 2 ft deep,
- Rating of trench per current code: 4 sf/lf
- Length of system: (750 sf)/(4 sf/lf) = 187.5 linear ft of trench

Proposed Aggregate Sizing per new Regulations:

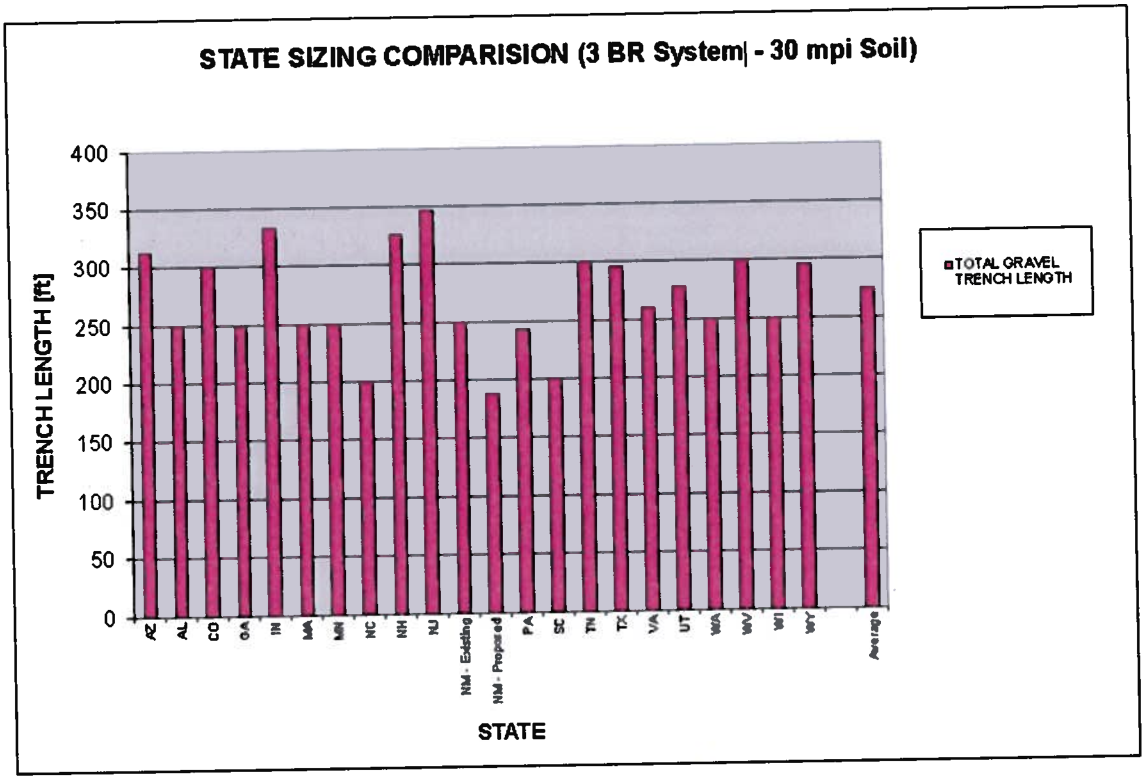
- Design Flow: 375 gpd
- Required square footage: (375 gpd)x(2 sf/gpd) = 750 sf
- Stone trench, 2 ft wide, 2 ft deep,
- Rating of trench per current code: 5 sf/lf
- Length of system: (750 sf)/(5 sf/lf) = 150 linear ft of trench

Sizing difference:

- (187.5-150)/187.5 = 0.20
- The system sizes will be 20% smaller

SIZING COMPARISIONS BETWEEM NEW MEXICO AND CERTAIN STATES

COMPARISON OF DESIGN FLOW, LOADING RATES AND SYSTEM SIZES FOR 30 mpi SOIL, 3 BEDROOM								
State	GPD PER BEDROOM	# OF BDRMS	DESIGN FLOW [GPD]	LOADING RATE [GPD/sf]	REQ'D ABSORPTION AREA [sf]	12"x 3 ft GRAVEL TRENCH RATING	TOTAL GRAVEL TRENCH LENGTH	
AZ	150	3	450	0.36	1250	4.00 sf/lf	313 lf	
AL	150	3	450	0.60	750	3.00 sf/lf	250 lf	
CO	150	3	450	0.50	900	3.00 sf/lf	300 lf	
GA	150	3	450	0.60	747	3.00 sf/lf	249 lf	
IN	100	3	300	0.30	1000	3.00 sf/lf	333 lf	
MA	110	3	330	0.33	1000	4.00 sf/lf	250 lf	
MN	150	3	450	0.60	750	3.00 sf/lf	250 lf	
NC	120	3	360	0.60	600	3.00 sf/lf	200 lf	
NH	150	3	450	0.34	1305	4.00 sf/lf	326 lf	
NJ	166.6	3	500	0.48	1040	3.00 sf/lf	347 lf	
NM - Existing	125	3	375	0.50	750	3.00 sf/lf	250 lf	
NM - Proposed	125	3	375	0.50	750	4.00 sf/lf	188 lf	
PA	133.33	3	400	0.55	727	3.00 sf/lf	242 lf	
SC	120	3	360	0.60	600	3.00 sf/lf	200 lf	
TN	150	3	450	0.50	900	3.00 sf/lf	300 lf	
TX	150	3	450	0.38	1184	4.00 sf/lf	296 lf	
VA	150	3	450	0.58	780	3.00 sf/lf	260 lf	
UT	x	3	x	0.90	833	3.00 sf/lf	278 lf	(UT 250 sf/bedroom)
WA	150	3	450	0.60	750	3.00 sf/lf	250 lf	
WV	150	3	450	0.50	900	3.00 sf/lf	300 lf	
WI	150	3	450	0.60	750	3.00 sf/lf	250 lf	
WY	150	3	450	0.38	1184	4.00 sf/lf	296 lf	
Average	(comparison to 12" deep gravel trench)						274 lf	



STATE SIZING COMPARISION (3 BR System| - 30 mpi Soil)
TRENCH LENGTH [ft]
400
350
300
250
200
150
100
50
0
AZ
AL
CO
GA
IN
MA
MN
NC
NH
NJ
NM - Existing
NM - Proposed
PA
SC
TN
TX
VA
UT
WA
WV
WI
WY
Average
STATE
TOTAL GRAVEL TRENCH LENGTH

Liquid Waste Program
2011 Stakeholder Outreach Initiative
Summary of, and Responses to, Stakeholder Recommendations
December 12, 2011

The New Mexico Environment Department (NMED), Liquid Waste Program initiated an outreach effort to obtain stakeholder recommendations on how to improve the program. The department distributed public notices on its website and by paper copy at each Field Office, and issued a statewide news release announcing public meetings and the opportunity to submit written comments. Notices also were sent to stakeholder organizations for distribution to their members. A total of 20 public meetings were held in Alamogordo, Angel Fire, Carlsbad, Clayton, Clovis, Espanola, Farmington, Hobbs, Las Cruces, Las Vegas, Los Lunas, Moriarty, Rio Rancho, Roswell, Ruidoso, Silver City, Santa Fe, Socorro, Taos, and Tucumcari. Meeting attendance, excluding NMED staff, ranged from zero in Las Vegas and Tucumcari, to approximately 40 in Farmington. Attendees included homeowners, contractors, realtors and local government officials, including several elected officials. Additionally, written comments were received from 11 individuals, 4 organizations, and several NMED staff members.

This document summarizes the recommendations that were received from stakeholders. In the following discussion, the Liquid Waste Regulations, 20.7.3 NMAC, will be referenced only by section and subsection (eg. 904 or 201.L).

NMED's comments, on issues where the department has developed a position, are provided in **green font**. These comments are offered for the purpose of continuing discussion with stakeholders, and do not necessarily reflect what will eventually be incorporated into NMED's petition for regulation amendments.

<u>General Suggestions</u>

- A number of stakeholders felt that some requirements in the Liquid Waste Program are overly prescriptive and overly burdensome. The Single Lot Policy, and the requirement that existing systems meet the requirements that were in effect at the time of initial installation, were provided as examples of regulations that impose unreasonable economic hardships on owners of liquid waste systems. **NMED agrees.**
- There was strong support for NMED's proposal of moving from the historical one-size-fits-all set of regulations, to regulations that are more specific to the hydrogeologic conditions of specific areas. **NMED is going to proceed with its proposal.**

<u>Scope</u> – There was mixed reaction to the idea of raising the 2,000 gpd limit in the scope of the regulations to 5,000 gpd. While the majority of comments supported the idea, some felt that discharges of this magnitude should remain under the authority of WQCC regulations. Some suggested that, if the limit is raised, advanced treatment should be required for discharges greater than 2,000 gpd, and that NMED staff should receive

additional training on advanced treatment. Additionally, the question of whether designing a greater than 2,000 gpd system is within the practice of engineering was raised. The Groundwater Quality Bureau noted that some of the permitted facilities in this discharge range have contaminated groundwater in excess of standards, and that transfer of these facilities to the Liquid Waste Program would remove these facilities from the authority of the WQCC abatement regulations. **NMED is not going to propose to increase the scope of the regulations to 5,000 gpd at this time.**

Single Lot Policy – There is substantial dissatisfaction with this policy. The public has provided examples of how the application of this policy does not serve its original purpose of protecting groundwater from one or more large, but less than 2,000 gpd, systems located in close proximity to each other. Re-platting lots to accommodate the policy was identified as a book-keeping exercise that does not change the physical characteristics of the wastewater discharge, or of the site, and provides no additional groundwater protection. **NMED agrees, and is drafting a revised Single Lot Policy with the Groundwater Bureau.**

Definition of "approved" – A number of Liquid Waste Permits were given approval for construction, but were never granted final approval for operation. These systems typically were not inspected by NMED either because department inspectors were unavailable at the time of completion, or because the installer failed to call for an inspection. The draft amendment to the definition of "approved" would have the effect of invalidating permits for a large number of existing systems. **NMED does not believe it is fair to the owners of these systems, many of whom did not own the system at the time of construction, to invalidate the permits years after installation. NMED is drafting a procedure for granting operational approval for existing systems in this category.**

Definition of "irrigation" – An installer noted that the proposed definition may conflict with provisions in the Uniform Plumbing Code. **(NMED is looking into this issue.)**

Hydrogeologic Vulnerability Mapping – This proposed regulation was generally well received. Many stakeholders agreed with NMED's position that the less than 30% gravel requirement (703.I) and lot size requirements (301) should be adjusted to reflect hydrogeologic sensitivity in some areas of the state.

- It was suggested that the area west of Alamogordo, where groundwater TDS naturally exceeds 10,000 mg/L, should be immediately exempted from the lot size requirements. **NMED agrees.**
- It was suggested that areas on the mountain slopes in Angel Fire, with clay soil and/or deep groundwater, should be immediately exempted from the lot size requirements. **NMED agrees.**
- There seemed to be general consensus that, if the minimum lot size is lowered in areas with low groundwater vulnerability, it should not be set smaller than ½ acre. **NMED agrees.** Concerns were raised, however, that ½ acre lots may not have enough suitable area to designate for the 50% drainfield replacement area

required by 201.H. Please see the comment regarding regulation 201.H in the Drainfield Issues section below.

- One member of the public suggested that the proposed depth to groundwater requirement of 400 to 600 feet be replaced with language requiring 100 feet of vadose zone (which would mean a 100 foot depth to groundwater). **NMED disagrees. A depth to groundwater of 100 feet is well within the range that ½ acre lots have caused widespread groundwater contamination.**

Qualification Requirements

- Homeowner Installations – Several people recommended that homeowner installations be outlawed, while others suggested that the qualification requirements for homeowners be raised. **The qualifications for homeowner installation were just raised by the EIB in amendments to 904 that became effective on November 21, 2011.**
- Installer Specialist – This proposed regulation is being well received by many contractors who would like to see it implemented. Concerns have been raised, however, that the privilege of self inspections could be abused since the installer and inspector would be the same entity. One contractor alleged that approximately 95% of the systems being installed today do not comply with the regulation and that the contracting industry lacks sufficient training and honesty to allow them to perform self inspections. **NMED is unaware of any data to support the assertion that 95% of systems now being installed do not comply with the regulations. While there would be potential for abuse, NMED believes that the Installer Specialist provision, if implemented, would result in a net increase in compliance.**
- Factory Certification for MSPs – Concerns were expressed that regulation 903.B, requiring that maintenance service providers be factory certified, restricts free-market competition and enables monopolies and price gouging. An analogy was made to motor vehicle laws that require automobile owners to maintain their vehicles in safe working condition, but do not require that maintenance be provided only by factory certified mechanics. It was recommended that the requirement for factory certification of MSP's be repealed. **NMED agrees. It should be noted that NSF requires that two years of service be included in the purchase price for advanced treatment systems. NMED is investigating whether MSPs may have been charging clients for service calls that were already paid for in the purchase price.**
- Generic MSP – Several stakeholders suggested that qualifications for a generic maintenance service provider be established. **NMED agrees.**
- Inspector Qualifications – One homeowner felt that, due to potential conflicts of interest, only certified government employees should be authorized to perform inspections. **In an ideal world, this idea might be practical. NMED, however, does not have sufficient funding and staff to assume the responsibility for all inspections.**
- Approved Training - One installer commented that the list of educational curricula currently approved by NMED should not be allowed for qualification as

an Installer Specialist on the basis that the training is not specific enough to installing. **NMED disagrees. Much of the approved training is relevant to site evaluation, design and installation.** This installer also pointed out that NMED had taken the position that the former Education Steering Committee was illegal, and raised questions as to the legality of NMED's approval of educational curricula that had been recommended by the Committee. **NMED disagrees. The legality of the Education Steering Committee had no bearing on the quality and usefulness of the curricula that were reviewed by the Committee, which served only to make recommendations, and on the approval of the curricula by the NMED Secretary.**

Property Transfer Inspections

- There is strong support from the industry to allow properly qualified third parties to inspect unpermitted systems. **NMED agrees, and will propose amendments where third parties would be allowed to inspect unpermitted systems.**
- Banks are not being required to do property transfer inspections on foreclosure sales, and this is not fair to other sellers who are required to do the inspections. **NMED agrees, but this is an enforcement issue that does not require amendments to the regulations.**
- It was suggested that real estate contracts also should be subject to property transfer inspections at the time the contract is signed. **NMED agrees, and is drafting language to clarify this inspection requirement.**
- Several realtors commented that the cost of pumping and inspection was exorbitant and burdensome for property sellers, especially in the current economic climate. It was suggested that property transfer inspections be valid for a longer period of time, ranging from 1 to 5 years, if the system has not been modified. **NMED believes that 5 years is too long of a time to provide the intended buyer beware protection of the regulation.**
- One installer suggested that only licensed contractors with NAWT training be allowed to perform property transfer inspections. **The qualifications for third party inspectors were just amended by the EIB in amendments to 904 that became effective on November 21, 2011.**
- One installer recommended that maintenance service providers for advanced treatment systems be notified in advance of property transfer inspections by other parties to prevent accidental damage to the systems. **NMED agrees.**

Existing Liquid Waste Systems – Regulations 201.L and 401.J.1 require that existing liquid waste systems meet the requirements that were in effect at the time of initial installation. Consequently, a number of properly functioning systems have had to be replaced due to non-conformance with whatever prescriptive regulations were in effect at the time of initial installation. These situations typically occur during property transfers, and the person selling the home, who is now saddled with the cost of replacing a properly functioning system, is quite often not the original owner who had the non-compliant system installed. It was recommended that such systems not have to be replaced if they are, in fact, functioning properly and are not too close to water wells or water bodies. **NMED agrees, and will propose to amend the requirements for existing systems.**

Tanks

- Plastic Tanks – Several installers suggested that plastic tanks be outlawed, or that more stringent requirements be imposed on the installation and pumping of plastic tanks. **NMED disagrees. Plastic tanks are suitable when properly installed, and some of the newer plastic tanks are considerably stronger than older models.**
- Concrete Strength – One installer suggested that the strength be increased to 4500 psi. **NMED is looking into this recommendation.**
- Vents – One installer suggested that vents be required in septic tanks to control the accumulation of gasses that can damage concrete. **NMED disagrees. Properly constructed septic tanks should vent to the atmosphere thru the building sewer system. Additionally, the vents could create odor issues and other problems in the backyards of homeowners.**
- Tank Inlets – Two installers suggested that inlets be required to be watertight, such as by requiring flexible boots as are now placed on the outlet side. **NMED agrees.**
- Effluent Filters – One installer suggested that all filters have handles extended to within 6" of the top of the access riser. **NMED agrees.**
- Access Risers – Two installers suggested that five gallon buckets, trash cans, rain barrels, metal drums, dry staked cinder blocks, and single walled pipe not be allowed to be used as access risers. **NMED agrees.**
- Cesspools – One member of the public felt that cesspools should still be allowed if caliche or another low permeability layer existed between the bottom of the cesspool and groundwater. **NMED disagrees on the basis that groundwater pollution is not the only potential hazard to public health and safety that cesspools pose. Cesspools can create hazards of entrapment, asphyxiation and drowning, and these hazards can increase as cesspools age and deteriorate. Additionally, cesspools allow untreated human waste to directly enter the soil, as opposed to the effluent that has undergone primary treatment as provided by a properly functioning septic system.**
- Holding Tanks – It was pointed out that the existing language of 809.A, 809.B and 809.O conflict with each other. Rule 809.A contains a residential-only provision, while the other rules mention commercial holding tanks. **NMED agrees.**

Drainfield Issues

- Tire Chips – One installer reports that tire chips used as drainfield aggregate have floated up to the surface and that children have suffered puncture injuries from the steel threads. Consequently, he no longer installs tire-chip drainfields. **NMED has asked the installer to provide documentation of the flotation incidents,**

including what kind of fabric or other cover was placed on top of the tire chips in the drain field.

- Six-Foot Maximum Trench Depth – The scientific justification for the maximum trench depth of 6 feet in the existing regulation was questioned, especially if groundwater is deep. This requirement was identified as a one-size-fits-all rule that is not appropriate for the entire state. **NMED agrees, and is developing an amended rule.**
- Low-Pressure Dosed Systems – Two installers recommended that section 808 be re-written. **NMED agrees, and is working with stakeholders to amend 808.**
- Drainfield Sizing – One installer recommended that the 30% reduction for proprietary products be eliminated, and that 703.1 application rates be increased from 2.0 to 2.25 sqft/gal.day and 5.0 to 5.7 sqft/gal.day. An NMED inspector recommended that sizing requirements for clay soils were too cost prohibitive and should be reduced. **The 30% reduction rule and application rates were adopted as regulations after extensive review and discussions with experts. Any amendments to these regulations should have a solid scientific basis.**
- Replacement Area Requirement – The enforceability of the requirement for a 50% drainfield replacement area (201.H) was questioned. Many homeowners are unaware of such designated areas, and there is no practical way to prevent local officials from issuing building permits for the designated area. It was suggested that a drainfield replacement area is a good idea, but should not be a permitting requirement. **NMED agrees, and will propose to delete this requirement.**
- Flood Irrigation Setback Requirements – Two installers commented that, while installing drainfields outside of irrigated areas is preferable, there is sometimes no other place to install the drainfield at some sites. Both installers believed that provisions should be written into the regulations whereby drainfields can be installed in irrigated areas, with protection from percolating irrigation water, when necessary. **NMED does not understand why the existing variance option is not practical for these rare situations.**
- Drainfields Under Paved or Covered Areas – Similar to the issue of drainfields in irrigated areas, one installer pointed out that drainfields sometimes have to be installed under parking lots or other paved or covered areas. It was suggested that the regulations allow this with an increase in size to compensate for the lack of expected evapotranspiration. **NMED does not understand why the existing variance option is not practical for these rare situations. Additionally, the prohibition against constructing drainfields under paved areas is contained in the Uniform Plumbing Code (UPC), and this could create problems for licensed contractors who must comply with UPC.**

Advanced Treatment

- Cost of Advanced Treatment Technology – Several stakeholders identified the need for more affordable technology for advanced wastewater treatment. **NMED agrees, but is unable to control free-market prices or to develop and market technology of its own.**

- RV Waste – There is support for exempting homeowners, who have a single RV for occasional use, from the pre-treatment requirements. **NMED agrees, and will propose such an exemption.** An RV park owner requested that NMED administer the requirement for pre-treatment of this high-strength waste consistently, and that the department issue guidance on what options are available to small RV park owners to provide pre-treatment. **NMED agrees, and is developing such guidance.**
- High-Strength Waste – Several stakeholders identified the need to address high-strength waste. One installer suggested that liquid waste systems treat fast-food waste to less than 100 mg/L BOD and less than 15 mg/L oil and grease prior to discharge to the soil treatment unit. **NMED agrees that treatment requirements for high-strength waste need to be clarified, and will ask the WTAC to put this issue on their agenda for a future meeting.**

Split-Flow (Segregated-Waste) Systems –

- One installer provided a technical paper written by Dr. Robert L. Siegrist in 1977 that specifically discussed the suitability of using of use of evapotranspiration (ET) systems to dispose of segregated toilet waste that has undergone sedimentation. The installer proposed amendments to 814 to allow the use of ET systems to dispose of toilet waste in split-flow systems. **NMED agrees, and will incorporate the suggested amendments into its revised petition.**
- Another installer questioned the proposed language that did not require primary treatment of gray water prior to subsurface discharge. **The gray-water statute 74-6-4.L NMSA, and regulation 810, allow gray water to be discharged directly into soil without any treatment. The imposition of treatment requirements for these gray water discharges would need to have a solid scientific basis, and would require amendment of the statute as wells as the regulations. Regulation 811, however, for gray water flows larger than 250 gpd, does require "a treatment unit".**

Composting Toilets – One member of the public would like to see the rules regarding composting toilets relaxed to encourage greater use of this technology. **NMED agrees, and has already proposed such amendments in its April 2011 petition.**

Grease Traps – One installer suggested that grease traps be inspected by NMED, and that standards and design requirements be established.

Design Flow

- There is unanimous agreement that existing definition of "bedroom" which is used to calculate design flow is ambiguous and needs to be clarified. **NMED agrees, and will propose clarifying language.**
- One installer recommended that design flow assumptions not be amended to avoid further inconsistency with the Uniform Plumbing Code and to avoid organic overloading of drainfields. **This is a topic that should be discussed**

further. The current wastewater design flow assumptions specified in the regulations are believed to be larger than what typical households actually discharge. This is due to the installation of water conserving appliances and fixtures and due to water conservation practices.

- One member of the public suggested that design flow be based on actual residential water usage, rather than on the number of bedrooms in the house. **NMED disagrees. Occupancy and actual residential water usage can change over time. Using bedrooms to calculate design flow, while not a perfect method, is the only practical way to issue permits.**

Animal Waste – It was suggested that kennel, veterinary and other animal waste should not be excluded from liquid waste systems, but that design flow for animal waste facilities need to be reviewed. **NMED agrees.**

"Completely Dimensioned" Site Plans – One installer would like to see this requirement clarified to be clear that survey-accurate plans are not required. **NMED believes the existing language is clear, and does not require survey-accurate site plans unless needed for a specific setback issue.**

100-Foot Setback from Drainfield to Private Domestic Well – One installer has suggested that this setback be reduced since some other states require less than 100 feet. **NMED disagrees, and is unaware of any scientific justification for replacing the existing one-size-fits-all rule with another one-size-fits-all rule.**

Permit Review Deadline – One installer has suggested that the deadline for NMED action on a conventional permit application be reduced from 10 working days to 5 working days. **NMED field staff endeavor to act on permits as soon as possible, typically well within the 10 working-day deadline. Given the hiring freeze and current vacancy rates, however, NMED does not support reducing the regulatory deadline from 10 to 5 days.**

Enforcement

- The industry wants to see more enforcement by CID and NMED against unlicensed contractors, and against licensed contractors who violate the Liquid Waste Regulations. Specific concern was expressed that persons who have the NAWT inspector certification, but who do not hold a valid and appropriate CID license, are performing unlicensed construction and repair work. **NMED agrees.**
- Increased enforcement was requested to control the proliferation of illegal unpermitted systems being installed by homeowners and persons renting lots for RV's and mobile homes. **NMED agrees.**
- One installer suggested that Notices of Violation (NOV) be appealable. **NMED disagrees. A NOV is a warning that has no legal status. Creating an appeal mechanism would be costly and unnecessary.**

Connections to Public Sewer – One installer suggested language that would make 201.E consistent with the Uniform Plumbing Code regarding when connections to public sewer are required. The clarifying language would allow homeowners to keep using their septic systems in some cases. **The EIB cannot promulgate regulations that will override ordinances adopted by local sewer authorities.**

Wastewater Technical Advisory Committee (WTAC) – One installer suggested that technical people should be appointed to the WTAC. **The WTAC membership is prescribed by statute, and the existing language is not clear with regard to expertise in the field of small onsite wastewater systems versus larger centralized wastewater systems.**

Public Funding for Wastewater Infrastructure

- Public funding has long been made available through grants and loans, pursuant to the federal Clean Water Act, for example, to improve public wastewater infrastructure. Persons who live in houses served by onsite wastewater systems pay taxes, but get no government benefits in the way of improvements to wastewater infrastructure. It was suggested that the government establish a program to provide taxpayer-funded assistance to households that use onsite wastewater systems. **This is an issue that has been recognized by both homeowners who utilize onsite wastewater systems, and by the onsite wastewater industry, throughout the United States for many years. Changing the paradigm of public funding for wastewater infrastructure will require legislation at both the national and state levels. This suggestion will be forwarded to the NMED Construction Programs Bureau.**
- It was also suggested that incentives be made available for the extension of public sewerage service into areas served by septic systems when the public wastewater treatment plants have unused capacity. **This suggestion will be forwarded to the NMED Construction Programs Bureau.**

NEW MEXICO
ECONOMIC DEVELOPMENT
Department

SUSANA MARTINEZ
GOVERNOR

JON BARELA
CABINET SECRETARY DESIGNATE

SMALL BUSINESS-FRIENDLY TASK FORCE REPORT

APRIL 1, 2011

Over the past 90 days, the Small Business-Friendly Task Force began the process of looking into regulations and rules from state agencies and departments to determine how, without jeopardizing the environment, health, safety or welfare of New Mexicans, rescinding or revising a rule or regulation could better improve the environment for small businesses in the state. All state agencies and departments were asked to submit all pending regulations and those rules and regulations currently in place that could be identified as benefiting business if they were revised or rescinded. Over the course of 90 days, the task force met, reviewed the rules and regulations and members gave their input. The task force looked over regulations that affect all industries; from food service, construction, health care, energy production and agriculture. The members of the task force either own their own small business, represent an organization that serves on behalf of several thousand New Mexico small businesses or are part of a company that contracts with local small businesses. Collectively these members represent more than ten thousand small businesses around the state. Below are the recommendations of the Small Business-Friendly Task Force, recommendations that the task force believes will benefit New Mexico's small businesses so they are able to create jobs and keep New Mexico competitive.

State rules and regulations should not be more stringent than federal standards. The first motion of the Small Business Task Force was to propose that state rules and regulations across the board be no more stringent than federal requirements and to correct any rule or regulation that requires more regulation than federal standards.

Revive the Small Business Regulatory Advisory Commission (SBRAC). The legislation to begin the Small Business Regulatory Advisory Commission was carried by Speaker Ben Lujan in 2005 to review regulations and its impact on small businesses. It is an underutilized resource that has good language about reviewing regulations. The commission was also an idea put forth by the U.S. Chamber of Commerce and used by other states. In addition to reviewing regulations, businesses can report problematic regulations to the commission. The task force recommends reviewing current members of the SBRAC and their status. They also recommend having a full and fair review by economists from a neutral party such as Workforce Solutions to provide SBRAC with economic impact analysis of the regulations. This would allow for the use of investigatory dockets as part of the rule making process with the agencies.

The task force recommends that state agencies adhere to their statutory responsibility to send rules and regulations from their department to the Economic Development Department to be reviewed by SBRAC and continue the work of the Small Business-Friendly Task Force whose objective was to review regulations for up to 90 days from the signing of the executive order on January 1, 2011.

Utilizing the Office of Business Advocacy. The Office of Business of Advocacy opened its doors on January 10, 2011, as a direct initiative from Governor Susana Martinez and Secretary-Designate Jon Barela. EDD's Office of Business Advocacy would potentially establish a Web-based "whistleblower" complaint log and phone-based hotline for businesses to confidentially communicate their complaints about permits or regulations or to help business navigate through state government. Companies often do not want to be seen or labeled as "troublemakers" by making public complaints. If they have do have complaints about any state agency, this would ensure that companies would have confidentiality if they bring up problems with departmental practices or policies through the whistleblower program. The Office of Business Advocacy would administer this program and investigate complaints.

Employees in agencies and the permitting and licensing process. Beyond changing a rule or regulation is the enforcement and handling of regulations and rules, particularly with permitting, by mid-level employees. An overarching theme small businesses have observed is the difficulty working with mid-level managers at NMED and other departments who have an anti-business agenda despite changes in leadership at the exempt-employee level. The recommendation is to have businesses facing problems with agencies call the Office of Business Advocacy.

ENVIRONMENT

Become an observer in the Western Climate Initiative. The task force recommends that New Mexico not withdraw completely from the Western Climate Initiative but that it moves to an observer status instead of being an active participant. They also suggest removing New Mexico from the Western Climate Initiative as a partner with California in Cap and Trade and to remove the New Mexico-only Cap and Tax. They believe that the green economy is important; therefore, the task force would like New Mexico to still be at the table. However, due to the lack of consensus from the scientific community on climate data, the task force recommends limiting state resources that are allocated to the WCI. They recommend New Mexico move to more of a "wait and watch" for the science status similar to states such as Utah, Washington and Oregon who are not part of the cap and trade program. The task force also proposes working with other western governors to delay the adoption of new air standards. Another recommendation is to review the three New Mexico members of the WCI and their responsibilities.

Environment regulations. Attached to this report are several regulations and rules that the task force recommends the Environmental Improvement Board, Oil Conservation Commission and Mining Commission review. In addition to the attached regulations from the NM Environment Department, the task force has identified the following rules as priorities.

<u>Oil Conservation Commission rules</u>:

- 19.15.5 NMAC "Enforcement and Compliance". This rule will be reviewed as part of a review of oil and gas enforcement processes and policies to ensure that requirements are enforced fairly and reasonably.
- 19.15.17 NMAC "Pits, Closed Loop Systems, Below Grade Tanks, and Sumps". The department will review the changes made to this rule in recent years to determine if any of the additional requirements are creating costly burdens to the regulated community without significantly improving environmental protection.
- 19.15.36 NMAC "Surface Waste Management Facilities". Same review as 19.15.17.
- Allow Provisional Approval of Form C-104. EMNRD/OCD Form C-104 is required for new wells. Currently, wells cannot produce until the form is approved. This delay hurts well

profitability and job creation, and can permanently damage some types of wells. The task force recommends allowing new wells to produce pending approval of this form.

Mining Commission rules:

- 19.10.1 "General Provisions" and 19.10.3 NMAC "Minimal Impact Operations". The Department will propose revisions to these rules and definitions that impact small mining operations to streamline the permitting process and insert deadlines for review.

- 19.10.12 NMAC "Financial Assurance Requirements". The Department will propose rule revisions to reduce the time for release of financial assurance instruments at small mining operations that have completed most reclamation obligations. This may require a statutory change also.

Environmental Improvement Board:

- 20.2.3 NMAC "Ambient Air Standards". Revise based on current scientific data if adequate funds are available to hire a toxicologist to do a health study of existing state standards

- 20.2.350 NMAC "Greenhouse Gas Cap-and-Trade Provisions". Recommend to revise.

- 20.2.300 NMAC "Reporting of Greenhouse Gas Emissions". Revise or if 20.2.350 NMAC is rescinded, rescind.

- 20.2.301 NMAC "Greenhouse Gas Reporting Verification Requirements". Rescind only if 20.2.350 is not in place.

- 20.6.4.9 NMAC "Outstanding National Resource Waters". Recommend to revise.

- 20.6.6 NMAC "WQCC Dairy Rules". Not federally required therefore recommendation is to rescind.

Environment permitting. To address a large backlog and many complaints about environmental permitting, the environment subcommittee recommends working with NMED to develop a fast-track environmental permit process. The deputy secretary of NMED, has agreed to name a six member team from his department to begin work on a new procedure for businesses to receive an expedited application for the permit(s) they need. NMED has also agreed to develop a "Small Business Committee" that would work with EDD Office of Business Advocacy to solve problems with regulations or permitting. NMED is planning on conducting surveys to collect opinions and data from industry to improve customer service.

AGRICULTURE

19 NMAC 32.2 – Trapping & Furbearers. This rule establishes methods, open seasons, and bag limits for the harvest of protected furbearers. Significantly different than any other hunting in New Mexico, the harvest of furbearers is generally conducted for personal income from the sale of pelts to the fur industry. The state's economy has limited influence from small businesses that exist specifically to participate in this industry as well as indirect support to local economies by trappers using local businesses. Trapping has historically been influenced by market demand as opposed to any allowances

that rules afford. The only potential revision to current rule that could enhance the economic environment would be localized to the Gila and Apache national forest region of New Mexico, where there is a current ban on trapping on public lands while the department assesses the risks to Mexican gray wolves due to trapping. The future removal of this ban will be influenced by this assessment. Recommendation is to have the New Mexico State Game Commission review this rule.

CONSTRUCTION

Building Code/Energy Code. The task force recommends that the building code be reverted to international code standards through the Construction Industry Commission (CIC). It would be beneficial to small businesses to roll back the code to meet but *not exceed* national standards which they now do under the new code. The code would have to go through review process to roll back to base international requirement which satisfies requirement for ARA money state receives. The CIC, after holding public hearings and receiving public comments, could then decide whether or not to roll back.

License Consolidation. The task force recommends that CIC reduce categories that contain licenses under a certain number by either consolidating those categories with other categories or review to determine if the category is even needed. For example- "striping" has its own category; does that need its own category or could it be combined?

Currently there are too many classifications and CIC could determine a better way to combine categories. Also, workers could be cross-trained so they are licensed to do different but related tasks at the same site. One inspector for all aspects of construction would be much more efficient than a separate inspector.

Consolidation of Mechanical, Electrical and Plumbing Inspections. Since there is a mechanism for duel inspection, there is a cross training process that can have multidiscipline inspectors so the state is not running through the same project five or six times. This won't work in every instance but could work in some smaller projects to have a multidiscipline inspector. Also recommend having a residential inspector career path that gives steps for an inspector to become a general inspector. One of the frustrations of those in the inspector field is that they often feel it is a dead end job; this way, they would have the option to move up and become a housing inspector. There are even frustrations with commercial inspection that there is no room to grow one's career. And with mechanical, gas as well as electrical; there be could be one person overseeing inspections. Recommendation for RLD to create a Housing Bureau.

Continuing Education Requirements. Get standardization from CIC on continuing education (CE) credits required. CEs are different for a carpenter, electrician and mechanical person. Currently it is too restrictive on who can provide CE credits, availability and number of classes and who can teach classes. For certain parts of the construction industry it is very restrictive. If a class fills up, there are no back up classes and someone could lose their license before the next class is available. The task force recommends allowing training that is done in-house as long as training matches the requirements.

Photovoltaic System Installation Determination. The past administration issued a mandate that every photovoltaic installer be a licensed journeyman; this mandate costs solar installers millions of dollars. Recommend that this mandate is rolled back if it has not already gone in front of CIC.

RLD is also looking to add a renewable energy seat in its department.

Wind Turbine Guidelines. Needs to be completely reviewed and rolled back to be more general and user friendly; it seems as if current guidelines were written for a specific project and not the entire wind turbine industry.

Prevailing Wage. The task force recommends going to a different categorization scale. The Public Works Minimum Wage Act, as modified by SB 33, does not specify specific categories of workers for the purpose of establishing prevailing wages. It does call for assigning to "classes of laborers and mechanics", the same wage rates and fringe benefit rates used in collective bargaining agreements that govern predominantly similar classes or classifications of laborers and mechanics for the locality of the public works project and the crafts involved. There is a fair amount of latitude in establishing the classes and classifications and localities. The pre-SB 33 regulations adopted under the act provided very specific and detailed breakdowns of crafts, but there doesn't seem to be anything about those classifications being set in stone. The new regulations implementing SB 33 could adopt quite different, but still rational, groupings, perhaps with a view to minimizing the cost to government of public works projects.

HEALTH AND HUMAN SERVICES

Developmental Disability Waiver. Recommendation is to establish a task force comprised of a broad spectrum of stakeholders including Department of Health personnel, agency representatives, individuals served, and family members, to review the current rules to see what could be streamlined or eliminated of the 170 pages of regulations governing services provided by business in serving the 4,000 individuals on the Waiver.

1) Use this re-write opportunity to review all 170 pages of the current regulations governing agencies serving those individuals on the DD Waiver in an effort to streamline them, make them more understandable and less burdensome.

2) Make the draft of the re-write immediately available to the public and hold hearings on the proposed rule changes before they are sent to the U.S. Centers for Medicare & Medicaid Services, so there is still opportunity for input from those businesses and individuals who will be significantly affected by these changes for the next several years.

CHILD CARE

A Child Care subcommittee task force was formed. Invitations to participate covered all corners of the state and all types of providers. In addition, key CYFD staff members were invited. Prior to formal meetings, an invitation to provide feedback was sent out to an electronic list of over 1,200 people. From there, the recurring suggestions were narrowed down. Two meetings were held to discuss the recurring suggestions.

Over 70 percent of New Mexico families need access to child care in order to work and go to school. Child care costs most families more than college, yet families with young children are the poorest members of our state.

Research shows that children learn the majority of what they will learn in a lifetime before the age of five, making the early years the foundation for future success. The challenge for this administration is to set regulation that allows centers to provide high quality care while remaining affordable and accessible to families, especially those who need access most.

The task force looked at some of the regulations and rules related to the child care industry, an industry that is vital to economic development in New Mexico and the development of New Mexico's most treasured resource - our children. Over the past decade the state has seen a huge increase in nationally accredited centers. In the past two years the reduction/elimination of quality initiatives, cuts to family eligibility, provider reimbursement rates, and an increase of unnecessary, illogical and burdensome regulations have begun a reversal of the progress the state has worked so hard to gain. Our best centers have begun limiting the number of low income children they will enroll. Centers are closing, or giving up accreditation, yet New Mexico remains one of the few states who pay family members to provide care. In addition licensed child care providers compete with non-licensed child care centers like Boys and Girls Clubs and YMCA. The task force is recommending some common sense changes to the licensing and regulatory process that will assure families have access to care during tough economic times. The following are the final recommendations.

Revert to the 2001 Child Care Regulations. The task force recommends reverting to the 2001 Child Care regulations while keeping Star Level 5 and all five levels of quality in place through "Aim High". All other quality standards would also remain in place as well as basic health and safety. Currently, Star levels are being affected by supplemental surveys that are not required by regulations. The task force also suggests with the exception of above reversion, keep the pay differential schedules for Star Levels as they are and restore Star Level I. (CYFD is aware of this request. They would like to know which regulations are in question. *This taskforce recommends that if individual regulations will be looked at, CYFD provide all new regulations since 2001 to this taskforce.)*

The task force believes most of the regulations in question were implemented in 2001 or later. Examples are:

a. An adult has to always be present with the door open as children go to the bathroom.
b. Hand sanitizer isn't allowed even though the CDC says it is better than hand washing.
c. Kids can wear each other's dress-up clothes but may not have their coats touching when hanging in the cubby.
d. Kids aren't allowed to stand in a line.
e. TTAPs count blocks and dress up clothes.
f. Parents must fill out daily permission slips for field trips (vs. approving a monthly schedule)
g. Children must be in sight AND sound at all times.

CYFD should not adopt the regulations of other agencies. Centers are already being regulated by the Environment Department, the Fire Marshall, Health Department, etc. Therefore, since each agency is an expert in their field, it is not necessary for CYFD to adopt the regulation as well, i.e., in November 2010, the federal government passed a law regarding cribs. Compliance is required by Dec 2012, yet CYFD added the regulations to state law *prior* to the federal bill being passed, requiring state providers to comply within 6 months (Dec of 2010).

Do not require a BA or MA for providers. This currently is not a regulation but the task force believes it is more effective and efficient to be able to show rubrics of training logs and base qualifications on experience instead of a college degree. State and National research shows that AA teachers with specialized training are producing outcomes at least equal to those with BA degrees. To require more than what is necessary to send children to school ready placed a financial burden on families, the state, and centers.

If a finding is not in regulation, it cannot be enforced. Self assessment tools cannot be used in a site visit. Currently providers are being written up for things that are not in regulations. For example: ECERS/ITERS are simply self-assessment tools and should not be a standard evaluating tool used by a state entity. It is not meant to be a regulatory tool but centers now are being written up by TTAPs. Interpretations of ECERS/ITERS are subjective. **Use regulations only for licensing visits.**

Child care centers are getting docked for things like not enough triangle blocks, markers are beginning to wear, or written up for jackets touching hanging in the cubby. There is currently inequality in regulators around the state. Example: centers getting written up for things in Southern NM that people are not getting written up for in the Northern part of the state.

Restore STAR Level I- In 2010 CYFD eliminated STAR Level I. Community feedback at public meetings will show great resistance from providers, yet CYFD continued with this change. One major objection is the fact that the biggest provider of state subsidized care is registered providers. This is sometimes called relative care. Some describe the state as having six levels of care, not just the five STAR levels. Level "0" are the unlicensed providers who receive state funds for care in their home. STAR I is a level of care that is far regulated beyond registered homes and assures basic health and safety are met. Eliminating STAR I but keeping registered homes seems to be a contradiction of any intent to improve quality. Additionally, when the state mandated all licensed providers be level II or higher, the reimbursement rate the state pays to centers increased. Free market and competition should drive centers to voluntarily increase their STAR level.

SMALL BUSINESS PROCUREMENT

Define Small Business. Legislation has a couple of different definitions for small business. Procurement code says less than $1.5M over three years.

State Vendor Registration. There is no clean, consolidated list of small businesses (let alone validated). State Purchasing captures this information for its vendor registration. The current tally is 330 out of 2000 businesses registered, which will be very low for the state. Work with local Chambers of Commerce to facilitate education of vendor registration and the registration of small business as vendors.

Small Business Procurement. Currently there is no preference for small business in the procurement code. Procurement agents are limited in their ability to award to small businesses.

Appendix One

New Mexico Environment Department Regulations

Division	Citation (NMAC)	Short Title	Federally Required	Potentially Affected Businesses or Industry Groups	Recommendations
Air Quality Bureau	20.2.3	Ambient Air Standards	Yes (SIP regulation)	Aggregate industry, oil and gas, power plans, manufacturing	Revise based on current scientific data if adequate funds are available to hire a toxicologist to do a health study of existing state standards
Air Quality Bureau	20.2.350	Greenhouse Gas Cap-and-Trade Provisions	No	Large oil and gas (not well head sites or most compressors), power plants, larger manufacturing	Revise
Air Quality Bureau	20.2.300	Reporting of Greenhouse Gas Emissions	No	Large oil and gas (not well head sites or most compressors), power plants, larger manufacturing	Revise or , if 20.2.350 NMAC is rescinded , rescind
Air Quality Bureau	20.2.301	Greenhouse Gas Reporting Verification Requirements	No	Large oil and gas (not well head sites or most compressors), power plants, larger manufacturing	Rescind only if 20.2.350 is not in place
Surface Water Quality Bureau	20.6.4.9	Outstanding National Resource Waters			Revise
Ground Water Quality Bureau	20.6.6	WQCC Dairy Rules	No	Dairies	Rescind
Hazardous Waste Bureau	20.4.1	Hazardous Waste Management	• Yes, to maintain primacy • Federal rules adopted by reference • EPA would implement regs of NM rescinded them • Exception Public – participation	• Facilities that generate, transport, treat store or dispose of HW • Extremely varied (paint shops; jewelry makers; refineries; national labs; military bases; auto mechanics)	• Revise to make permitting, hearing, and public participation requirements in line with the minimum required by the EPA

Ground Water Quality Bureau	20.6.2.3105.B	Water Quality Control Commission Discharge Permit Sewerage System Exemption	No	• Facilities that generate small volumes of sewerage effluent wastes • Extremely varied (schools, developers, housing, subdivisions, mobile home parks, RV parks, commercial businesses)	Revise WQCC rule to increase small volume sewerage system effluent permitting exemption to discharges of less than 5,000 gallons per day
Liquid Waste Program	20.7.3.904	Requirements for Certification	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Repeal rule and rewrite with stakeholder input
Surface Water Quality Bureau	20.6.4	Surface Water Quality Standards	Yes, EPA would promulgate if NM failed to do so	Facilities that discharge or potentially discharge water contaminants to surface waters of the state	Revise
Surface Water Quality Bureau	20.6.2.2000	Surface water protection	No, state does not have primacy for federal Clean Water Act Program	Facilities that discharge water contaminants to surface waters of the state but are not permitted by the US EPA or US Army Corps of Engineers	Revise
Surface Water Quality Bureau	20.4.2	Utility Operator Certification	Yes, program is required for state to receive federal drinking water set-aside funding	Municipal and other public water supply systems/public wastewater facilities	Revise
Liquid Waste Program	20.7.3.301	Lot size requirements	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Revise
Liquid Waste Program	20.7.3 302.1 303 605 703.F	Clearance Requirements	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Revise
Liquid Waste Program	20.7.3.A	Scope	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems,	Revise

				homeowners	
Liquid Waste Program	20.7.3.201	Design Flow	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Revise
Liquid Waste Program	20.7.3.703.j.2 and k.1	Disposal Field Design	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Repeal Rule
Liquid Waste Program	20.7.3.401	Permitting	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Revise
Liquid Waste Program	20.7.11.12	Payment of Fees	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Revise
Liquid Waste Program	20.7.3.601-605	Design of Advanced Wastewater Treatment Systems	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Revise
Liquid Waste Program	20.7.3.601.B	Design of Advanced Wastewater Treatment Systems	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Revise
Liquid Waste Program	20.7.3.903	Maintenance Service Providers	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Revise

Liquid Waste Program	20.7.3.901	Monitoring	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Revise
Liquid Waste Program	20.7.3.802	Privies	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Repeal
Liquid Waste Program	20.7.3.401	Permitting	No	Onsite wastewater system, contractors, home builders, realtors, businesses that utilize onsite waste water systems, homeowners	Rescind
Petroleum Storage Tank Bureau	20.5.4.35	PST Regs: Deadlines for Closings or Upgrading AST's	• No • Federal SPCC program in Dallas is more limited and not enforced much in NM	Retail oil gasoline industry Oil and lubrication facilities, railroads, warehouse, and fleet maintenance facilities, government and law enforcement facilities, construction companies	Delay upgrade deadline for 2 years, as per proposed rule revisions
Petroleum Storage Tank Bureau	20.5.17.20	PST Regs: Means Test to Determine Deductible	No	Retail oil gasoline industry Oil and lubrication facilities, railroads, warehouse, and fleet maintenance facilities, government and law enforcement facilities, construction companies	Revise
Petroleum Storage Tank Bureau	20.5.20.15	PST Regs: Preference for the Instate Business	No	Remediation contractors, owners/operators of storage tanks that have a release	Revise

Petroleum Storage Tank Bureau	20.5.4.15	PST Regs: Standards for AST Secondary Containment	No	Retail oil gasoline industry Oil and lubrication facilities, railroads, warehouse, and fleet maintenance facilities, government and law enforcement facilities, construction companies	
Petroleum Storage Tank Bureau	20.5.4.38	PST Regs: Alternate Methods	No	Retail oil gasoline industry Oil and lubrication facilities, railroads, warehouse, and fleet maintenance facilities, government and law enforcement facilities, construction companies, certified tank installers	Proceed with proposed rule revision to expand showing of alternate method
Petroleum Storage Tank Bureau	20.5.18.8	PST Regs: Operator Training	Yes, operator training is required by the 2005 Federal Energy Policy Act	Retail oil gasoline industry Oil and lubrication facilities, railroads, warehouse, and fleet maintenance facilities, government and law enforcement facilities, construction companies	Proceed with proposed revision to clarify rule of owners/operators
Petroleum Storage Tank Bureau	20.5.14.2	PST Regs: Tank Installer Certification	No	Retail oil gasoline industry Oil and lubrication facilities, railroads, warehouse, and fleet maintenance facilities, government and law enforcement facilities, construction companies, certified tank installers	Proceed with proposed revision to clarify rule of owners/operators
Air Quality Bureau	20.2.20	Lime manufacturing plants	Yes (SIP regulation)	Lime manufacturing plants	Rescind
Air Quality Bureau	20.2.36	Petroleum refinery sulfur	No	Refineries	Rescind
Air Quality Bureau	20.2.37	Petroleum Processing facilities	No	Refineries and natural gas processing plants	Rescind
Air Quality Bureau	20.2.38	Hydrocarbon storage facilities	No	Oil and gas industry	Revise or Rescind

Air Quality Bureau	20.2.72	Construction permits	Yes (SIP regulation)	Oil and gas, manufacturing, power plants, aggregate industry	Rescind
Air Quality Bureau	20.2.11	Asphalt process equipment	Yes (SIP regulation)	Asphalt plants	Rescind
Air Quality Bureau	20.2.12	Cement Kilns	Yes (SIP regulation)	Cement Kilns	Rescind
Food Program	7.6.2.8k(1-2)	Food service and food processing regulations permit feeds	No	All businesses and/or individual groups that serve food to the general public and pay a permit fee	revise
Food Program	7.6.2.14.E(1)	Bottled water processing monitoring requirements	No	All businesses or individuals that process and package bottled water products	Revise
Food Program	7.6.2.16	Home-based food	No	All businesses and/or individuals that prepare and sell non-hazardous foods to the public from their homes	Revise
Hazardous Waste Bureau	20.4.5	Clandestine Drug Lab Clean up	No	Property owners, Real Estate Agents, Lenders	Rescind
Pool Program		Lifeguard Requirements	No		
Pool Program		ORP Requirements	No		
Pool Program		PE signature and stamp for minor modifications	No	Permitted pool owners, engineers	Add provision in the rules for minor modifications not needing a P.E. signature
Radiation Control Bureau	20.3.6.606.f	20.3.6 x-ray in the healing arts	No	Dental, veterinary, medical and offices, universities and government agencies	Revise
Radiation Control Bureau	20.3.8.802A	Radiation Safety Requirements for Analytical X-Ray Equipment	No	Industrial, salvage yards, semiconductor manufactures (Intel), testing service business and universities and government agencies	Revise